TOOELE
ARMY
DEPOT

FINAL

CORRECTIVE MEASURES STUDY REPORT
GROUP C SUSPECTED RELEASES SWMUs
TOOELE ARMY DEPOT
TOOELE, UTAH

Contract No. DACA31-94-D-0060
Delivery Order No. 1

Prepared for:

TOOELE ARMY DEPOT
Tooele, Utah

Prepared by:

URS
Dames & Moore
7101 Wisconsin Avenue, Suite 700
Bethesda, Maryland 20814

DISTRIBUTION UNLIMITED
APPROVED FOR PUBLIC RELEASE

JULY 2001

Printed on Recycled Paper

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ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
BRAC	Base Realignment and Closure
CAO	Corrective action objective
CAP	Corrective Action Permit
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
COC	Contaminant of concern
COPC	Contaminant of potential concern
DCD	Deseret Chemical Depot
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
EQ	Exposure quotient
FFA	Federal Facility Agreement
ft^2	Square foot
HI	Hazard index
HQ	Hazard quotient
IRP	Installation Restoration Program
IWL	Industrial Waste Lagoon
LDR	Land Disposal Restrictions
µg/dL	Micrograms per deciliter
µg/g	Micrograms per gram
NPL	National Priorities List
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbon

ACRONYMS AND ABBREVIATIONS (cont'd)

RA	Risk assessment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSA	Reference study area
SAIC	Science Applications International Corporation
SVOC	Semivolatile organic compound
SWERA	Site-Wide Ecological Risk Assessment
SWMU	Solid waste management unit
TCLP	Toxicity characteristic leaching procedure
TEAD	Tooele Army Depot
TEAD-N	Tooele Army Depot – North Area
TEAD-S	Tooele Army Depot – South Area
TECA	Tooele Chemical Activity
TSDF	Treatment, storage, and disposal facility
UAC	Utah Administrative Code
UDEQ	Utah Department of Environmental Quality
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center (formerly USATHAMA)
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency (now USAEC)
VOC	Volatile organic compound
XRF	X-ray fluorescence
yd^3	Cubic yard

EXECUTIVE SUMMARY

This document is the Corrective Measures Study (CMS) Report for the Group C Suspected Releases Solid Waste Management Units (SWMUs) at Tooele Army Depot (TEAD; formerly the North Area), Tooele, Utah. It has been prepared for TEAD, in association with the U.S. Army Environmental Center (USAEC), in accordance with the Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (CAP; UT3213820894) issued to TEAD by the State of Utah.

The purpose of the CMS Report is to recommend a corrective measures alternative:

- For each SWMU for which the baseline risk assessment (RA) determined a significant threat to human health under the future residential land use scenario.

  – or –

- For each SWMU that poses a threat to the environment.

According to the State of Utah Administrative Code (UAC; Regulation 315-101-6(c)3), a site management plan must be prepared for SWMUs that pose a human health cancer risk greater than 1×10^{-6}, a noncancer hazard index (HI) greater than 1.0, or a modeled blood lead level greater than 10 micrograms per deciliter under the future residential land use scenario. The requirement for a site management plan is fulfilled by the CMS Work Plan and this CMS Report.

For SWMUs that do not pose an unacceptable threat to human health or the environment under current and likely future land use conditions, the CMS evaluates management measures (e.g., monitoring or deed restrictions), and may consider active corrective measures. For SWMUs that do pose an unacceptable threat to human health or the environment under current and reasonably anticipated future land use conditions, the CMS evaluates both active corrective measures (i.e., treatment technologies) and management measures.

The Phase II RCRA Facility Investigation (RFI) Report (SAIC, 1997) identified nine Group C SWMUs. The RFI recommended “no further action” for the PCB Storage Spill Sites (SWMU 53) and the Battery Shop (SWMU 55), which were determined not to pose unacceptable human health or environmental risks.

The CMS Report presents a detailed evaluation of the corrective measures alternatives developed in the CMS Work Plan (Dames & Moore, 2001) for the management of identified risks at the following Group C SWMU areas, which were determined in the RFI to pose human health or environmental risks:

- SWMU 49 – Stormwater/Industrial Wastewater Piping

  - Sewer Line – Southern Area
  - Sewer Line – Central Area
  - Sewer Line – Northern Area
  - Building 609
  - B Avenue Outfall
  - G Avenue Outfall
  - H Avenue Outfall
  - J Avenue Outfall
  - K Avenue Outfall.

- SWMU 50 – Compressor Condensate Drains

  - Building 613 Drain
  - Building 619 Drain.

- SWMU 51 – Chromic Acid/Alodine Drying Beds.

- SWMU 52 – Possible Drainfield/Disposal Trenches

  - SWMU 52B – Disposal Trenches
  - SWMU 52C – Charcoal Material Area
  - SWMU 52D – Horse Stable Area.

- SWMU 54 – Sandblast Areas

  - Building 604
  - Building 611
  - Building 637.

- SWMU 56 – Gravel Pit

  - Burned Area
  - Nonburned Area.

- SWMU 57 – Skeet Range.

The CMS Work Plan (Dames & Moore, 2001) identified potential corrective measures alternatives for each of the Group C SWMU areas. This was accomplished by developing corrective action objectives (CAOs) for the contaminants of potential concern (COPCs) in soil under the likely future land use scenarios. For SWMUs 49, 50, 51, 54, and 56, the likely future land use is commercial/industrial. For SWMUs 52 and 57, the likely future land use is residential.

The CAOs developed in the CMS Work Plan (Dames & Moore, 2001) included quantitative risk-based objectives and qualitative regulatory-driven objectives. COPCs were compared to quantitative CAOs to identify contaminants of concern (COCs). The CMS Work Plan identified corrective measures – which may include treatment technologies or management measures – that meet the qualitative and quantitative CAOs, and assembled them into corrective measures alternatives.

The corrective measures alternatives considered for the Group C SWMUs are listed below:

- SWMU 49 – Stormwater/Industrial Wastewater Piping
  - Sewer Line – Southern Area
    - Deed restrictions
    - Excavation, off-post treatment/disposal, and deed restrictions
  - Sewer Line – Central Area
    - Deed restrictions
    - Excavation, off-post treatment/disposal, and deed restrictions
  - Sewer Line – Northern Area
    - Deed restrictions
  - Building 609
    - No action
  - B Avenue Outfall
    - Deed restrictions
  - G Avenue Outfall
    - Deed restrictions
    - Excavation, off-post treatment/disposal, and deed restrictions
  - H Avenue Outfall
    - Deed restrictions
  - J Avenue Outfall
    - Deed restrictions
  - K Avenue Outfall
    - Deed restrictions.
- SWMU 50 – Compressor Condensate Drains
  - Building 613 Drain
    - Deed restrictions

  - Building 619 Drain
    - Deed restrictions
    - Excavation and off-post treatment/disposal.

- SWMU 51 – Chromic Acid/Alodine Drying Beds

  - Deed restrictions.

- SWMU 52 – Possible Drainfield/Disposal Trenches

  - SWMU 52B – Disposal Trenches
    - Deed restrictions

  - SWMU 52C – Charcoal Material Area
    - Excavation and off-post treatment/disposal

  - SWMU 52D – Horse Stable Area
    - Excavation and off-post treatment/disposal.

- SWMU 54 – Sandblast Areas

  - Building 604
    - No action

  - Building 611
    - Excavation, off-post treatment/disposal, and deed restrictions
    - Excavation, soil washing, and deed restrictions
    - Excavation, solidification/stabilization, and deed restrictions

  - Building 637
    - Deed restrictions.

- SWMU 56 – Gravel Pit

    - Deed restrictions
    - Excavation and off-post treatment/disposal (Burned Area only).

- SWMU 57 – Skeet Range

  - Excavation and off-post treatment/disposal
  - Excavation, soil washing, and off-post treatment/disposal
  - Excavation, solidification/stabilization, and off-post treatment/disposal.

The detailed evaluation of each corrective measures alternative considers technical criteria (including performance, reliability, implementability, and safety),

protection of human health, environmental assessment, administrative feasibility, and cost, as outlined below:

- Technical criteria

  - Performance – Evaluates the ability of the alternative to perform its intended function and to meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). Factors affecting performance – including site and waste characteristics – are also considered, along with the length of time the alternative maintains its intended level of effectiveness.

  - Reliability – Describes the long-term effectiveness and permanence of each alternative, and evaluates the adequacy of the treatment technology based on performance at similar sites, operation and maintenance (O&M) requirements, long-term environmental monitoring needs, and residuals management requirements.

  - Implementability – Assesses the technical and institutional feasibility of executing an alternative, including constructability, permit and legal/ regulatory requirements, and availability of materials. This criterion also addresses the length of time from implementation of the alternative until beneficial effects are realized.

  - Safety – Considers potential threats to workers, off-post residential communities, and the environment during implementation of the corrective measure.

- Human health assessment – Evaluates the extent to which each alternative protects human health. This criterion considers the classes and concentrations of contaminants left onsite, potential exposure routes, and potentially affected populations. Residual contaminant concentrations are compared to existing criteria, standards, and guidelines.

- Environmental assessment – Evaluates short- and long-term effects of the corrective measure on the environment, including adverse impacts to environmentally sensitive areas.

- Administrative feasibility – Considers compliance with applicable Federal, State, and local environmental and public health standards, requirements, criteria, or limitations.

- Cost – Considers capital and annual O&M costs for each alternative.

Based on the detailed evaluations conducted in this CMS, the ***recommended corrective measures alternatives*** for each SWMU are as follows:

- Deed restrictions
  - Stormwater/Industrial Wastewater Piping, Sewer Line – Southern Area (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, Sewer Line – Central Area (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, Sewer Line – Northern Area (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, B Avenue Outfall (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, H Avenue Outfall (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, J Avenue Outfall (SWMU 49).
  - Stormwater/Industrial Wastewater Piping, K Avenue Outfall (SWMU 49).
  - Compressor Condensate Drains, Building 613 Drain (SWMU 50).
  - Compressor Condensate Drains, Building 619 Drain (SWMU 50).
  - Chromic Acid/Alodine Drying Beds (SWMU 51).
  - Disposal Trenches (SWMU 52B).
  - Sandblast Areas, Building 637 (SWMU 54).
- Excavation, off-post treatment/disposal, and deed restrictions
  - Stormwater/Industrial Wastewater Piping, G Avenue Outfall (SWMU 49)
  - Sandblast Areas, Building 611 (SWMU 54)
- Excavation and off-post treatment/disposal
  - Charcoal Material Area (SWMU 52C)
  - Horse Stable Area (SWMU 52D)

  - Gravel Pit (SWMU 56)
  - Skeet Range (SWMU 57)

- No action
  - Stormwater/Industrial Wastewater Piping, Building 609 (SWMU 49)
  - Sandblast Areas, Building 604 (SWMU 54)

Table ES-1 summarizes the corrective measures alternatives evaluated in the CMS for the Group C SWMUs; also included are summaries of the results of the human health and ecological RAs, potential effects on groundwater, and identified COCs.

The CMS Report addresses how the alternatives reduce exposure to contamination, contaminant concentration, or contaminant migration.

These recommended corrective measures alternatives for Group C are presented to the public in the Decision Document. Once the recommendations are accepted, TEAD's RCRA Post Closure Monitoring and Corrective Action Permit will be modified to include the approved CMS Report and Decision Document.

TABLE ES-1
Summary of Corrective Measures Alternatives
Group C SWMUs

SWMU	Results of Human Health RA (a)						Results of Ecological RA (b)	Potential Effect on Groundwater?	COC (c)	Corrective Measures Alternatives (d)
	Industrial			Construction Worker						
	Cancer Risk	HI	Blood Lead	Cancer Risk	HI	Blood Lead				
STORMWATER/INDUSTRIAL WASTEWATER PIPING (SWMU 49)										
Sewer Line – Southern Area	NA (e)	NA (e)	NE (h)	8×10^{-11}	0.04	NE	NE	No	Metals	***Deed restrictions ($12,000)*** Excavation, off-post treatment/disposal, and deed restrictions ($47,000)
Sewer Line – Central Area	NA (e)	NA (e)	NE	2×10^{-6}	6×10^{-4}	NE	NE	No	SVOCs	***Deed restrictions ($12,000)*** Excavation, off-post treatment/disposal, and deed restrictions ($52,000)
Sewer Line – Northern Area	NA (e)	NA (e)	NE	5×10^{-8}	0.1	NE	NE	No	None	***Deed restrictions ($12,000)***
Building 609	NA (f)	0.4	NE	NE	0.3	NE	NE	No	None	***No action ($0)***
B Avenue Outfall	5×10^{-7}	0.1	5.8	5×10^{-8}	0.04	8.0	Moderate risk	No	None	***Deed restrictions ($12,000)***
G Avenue Outfall	8×10^{-5}	0.3	NE	7×10^{-6}	0.3	NE	Moderate risk	No	SVOCs	Deed restrictions ($12,000) ***Excavation, off-post treatment/disposal, and deed restrictions ($73,000)***
H Avenue Outfall	1×10^{-6}	0.01	NE	1×10^{-7}	0.004	NE	Low risk	No	None	***Deed restrictions ($12,000)***
J Avenue Outfall	4×10^{-7}	0.002	NE	3×10^{-8}	6×10^{-4}	NE	Moderate risk	No	None	***Deed restrictions ($12,000)***
K Avenue Outfall	3×10^{-7}	0.2	NE	2×10^{-8}	0.02	NE	Moderate risk	No	None	***Deed restrictions ($12,000)***
COMPRESSOR CONDENSATE DRAINS – BUILDINGS 613 AND 619 (SWMU 50)										
Building 613	NA (g)	NA (g)	NE	2×10^{-9}	0.008	NE	NE	No	None	***Deed restrictions ($12,000)***
Building 619	NA (f)	6×10^{-5}	NE	6×10^{-6}	0.2	NE	NE	No	Metals	***Deed restrictions ($12,000)*** Excavation and off-post treatment/ disposal ($26,000)
CHROMIC ACID/ALODINE DRYING BEDS (SWMU 51)										
	8×10^{-7}	0.4	6.0	7×10^{-8}	0.08	8.3	Moderate risk	No	SVOCs	***Deed restrictions ($12,000)***

TABLE ES-1 (cont'd)

SWMU	Results of Human Health RA (a)						Results of Ecological RA (b)	Potential Effect on Groundwater?	COC (c)	Corrective Measures Alternatives (d)
	Industrial			Construction Worker						
	Cancer Risk	HI	Blood Lead	Cancer Risk	HI	Blood Lead				
SANDBLAST AREAS (SWMU 54)										
Building 604	NA (f)	0.2	NE	7×10^{-7}	0.03	NE	NE	No	None	***No action ($0)***
Building 611	1×10^{-7}	1	17	1×10^{-8}	0.4	32	NE	No	Metals	***Excavation, off-post treatment/disposal, and deed restrictions ($120,000)*** Excavation, soil washing, and deed restrictions ($260,000) Excavation, solidification/stabilization, and deed restrictions ($210,000)
Building 637	2×10^{-6}	0.5	6	2×10^{-7}	0.08	9	NE	No	SVOCs	***Deed restrictions ($12,000)***
GRAVEL PIT (SWMU 56) (i)										
	2×10^{-7}	2	9.5	1×10^{-6}	0.5	16	Moderate risk	No	None	Deed restrictions ($12,000) ***Excavation and off-post treatment/ disposal (Burned Area only) ($240,000)***

TABLE ES-1 (cont'd)

SWMU	Results of Human Health RA (a)						Results of Ecological RA (b)	Potential Effect on Groundwater?	COC (c)	Corrective Measures Alternatives (d)
	Residential			Construction Worker						
	Cancer Risk	HI	Blood Lead	Cancer Risk	HI	Blood Lead				
POSSIBLE DRAIN FIELD/DISPOSAL TRENCHES (SWMU 52) (j)										
Disposal Trenches (SWMU 52B)	2×10^{-5}/ 1×10^{-5}	300/ 800	NE	5×10^{-7}	0.2	NE	Low risk	No	None	***Deed restrictions ($12,000)***
Charcoal Material Area (SWMU 52C) (k)	1×10^{-4}/ 8×10^{-5}	20/60	NE	7×10^{-7}	0.03	NE	Low risk	No	SVOCs	***Excavation and off-post treatment/ disposal ($550,000)***
Horse Stable Area (SWMU 52D)	3×10^{-6}/ 2×10^{-6}	0.03/ 0.07	NE	3×10^{-8}	0.002	NE	Low risk	No	Pesticides	***Excavation and off-post treatment/ disposal ($41,000)***
SKEET RANGE (SWMU 57) (j)(l)										
	2×10^{-1}/ 9×10^{-2}	1,000/ 3,000	NE/72	2×10^{-4}	20	2,000	High risk	No	Metals SVOCs	***Excavation and off-post treatment/ disposal ($1,400,000)*** Excavation, soil washing, and off-post treatment/disposal ($1,600,000) Excavation, solidification/stabilization, and off-post treatment/disposal ($1,500,000)

(a) Based on the Phase II RFI Report. In accordance with UAC 315-101, a SWMU requires active corrective measures if risks, HIs, or blood lead levels under the reasonably anticipated land use scenario exceed 1×10^{-4}, 1.0, or 10 µg/dL, respectively. The maximum risk, HI, and blood level are reported.
(b) RFI Report (SAIC, 1997).
(c) Contaminant of concern.
(d) The preferred corrective measures alternative for each SWMU is shown in bold italic type.
(e) NA = Not applicable. Industrial workers are not exposed to subsurface soil; because the piping system is located underground, surface soil samples were not collected in this area. Therefore, no risks or hazards are calculated for industrial workers.
(f) NA = Not applicable. None of the COPCs for the industrial worker have a toxicity value for cancer effects.
(g) NA = Not applicable. Surface soil samples were not collected.
(h) NE = Pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(i) Risks presented are for the Burned Area.
(j) The reasonably anticipated land use for SWMUs 52 and 57 is residential; therefore, residential adult/child risks are presented.
(k) Risks presented are for the charcoal material and surface soil area of SWMU 52C.
(l) Risks presented are for SWMU 57 soil, including lead shot.

1.0 INTRODUCTION

This document is the Corrective Measures Study (CMS) Report for the Group C Suspected Releases Solid Waste Management Units (SWMUs) at Tooele Army Depot (TEAD; formerly the North Area), Tooele, Utah. It has been prepared for TEAD, in association with the U.S. Army Environmental Center (USAEC), under Alternatives Development and Decision Documents for TEAD-North Area (TEAD-N), Contract No. DACA31-94-D-0060, Delivery Order No. 1. This CMS Report was developed in accordance with Module VII, Corrective Action, of the Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (CAP; UT3213820894) issued to TEAD by the State of Utah Department of Environmental Quality (UDEQ) in January 1991.

1.1 PURPOSE AND SCOPE

The CMS Report represents one of the major steps in the RCRA corrective action process of protecting human health and the environment from the chemicals released at a facility. In accordance with State of Utah guidance, this report is based on the evaluations and conclusions of the Phase II RCRA Facility Investigation (RFI) Report (Science Applications International Corporation (SAIC), 1997) and the CMS Work Plan (Dames & Moore, 2001). The RFI delineates the nature and extent of chemical constituents in the environment, and evaluates potential risks to human health and impacts to the environment. The CMS Work Plan identifies site-specific corrective measures alternatives that address the potential risks and hazards at each SWMU.

The purpose of this CMS Report is to analyze the corrective measures alternatives developed in the CMS Work Plan (Dames & Moore, 2001) for the seven Group C SWMUs determined in the Phase II RFI Report (SAIC, 1997) to pose unacceptable risks to human health under the future residential land use scenario, which must be evaluated per Utah Administrative Code (UAC) R315-101-5.2(b)(1). The objective in conducting the CMS is to protect human health and the environment during current and expected future land use. This does ***not*** include cleaning up the facility to standards that apply for other land uses. If other uses are considered in the future, it will be necessary to reevaluate the corrective measures alternatives identified for the Group C SWMUs.

The CMS Report is intended to be used in conjunction with the CMS Work Plan* (Dames & Moore, 2001); *most information presented in the work plan is not repeated in this report. The CMS Work Plan summarizes TEAD background information, including location, physical characteristics, history, present mission, future use, and previous investigations/regulatory overview. Also included for each SWMU are descriptions of background, summaries of contamination assessment from the Phase II RFI Report (SAIC, 1997), results of human health and ecological risk assessments (RAs), interim corrective actions (as applicable), identification of corrective action objectives (CAOs) and contaminants of concern (COCs), qualitative estimates of extent of contamination (as applicable), and development of corrective measures alternatives.

1.2 BACKGROUND

TEAD is located in Tooele Valley in Tooele County, Utah, immediately west of the City of Tooele and approximately 30 miles southwest of Salt Lake City (Figure 1-1). The U.S. Army Ordnance Department established the facility in 1942, and it was named the Tooele Ordnance Depot. It was redesignated as TEAD-N in August 1962; also at this time, the former Deseret Chemical Warfare Depot was renamed TEAD – South Area (TEAD-S). Both the North and South Areas of TEAD have been major ammunition storage and equipment maintenance installations that support other U.S. Army installations throughout the western United States. In 1996, TEAD-N and TEAD-S were designated as TEAD and Tooele Chemical Activity (TECA), respectively. In October 1996, TECA was renamed the Deseret Chemical Depot (DCD).

The current missions of TEAD are:

- To receive, store, issue, maintain, and dispose of munitions
- To provide installation support to attached organizations
- To operate other facilities as assigned.

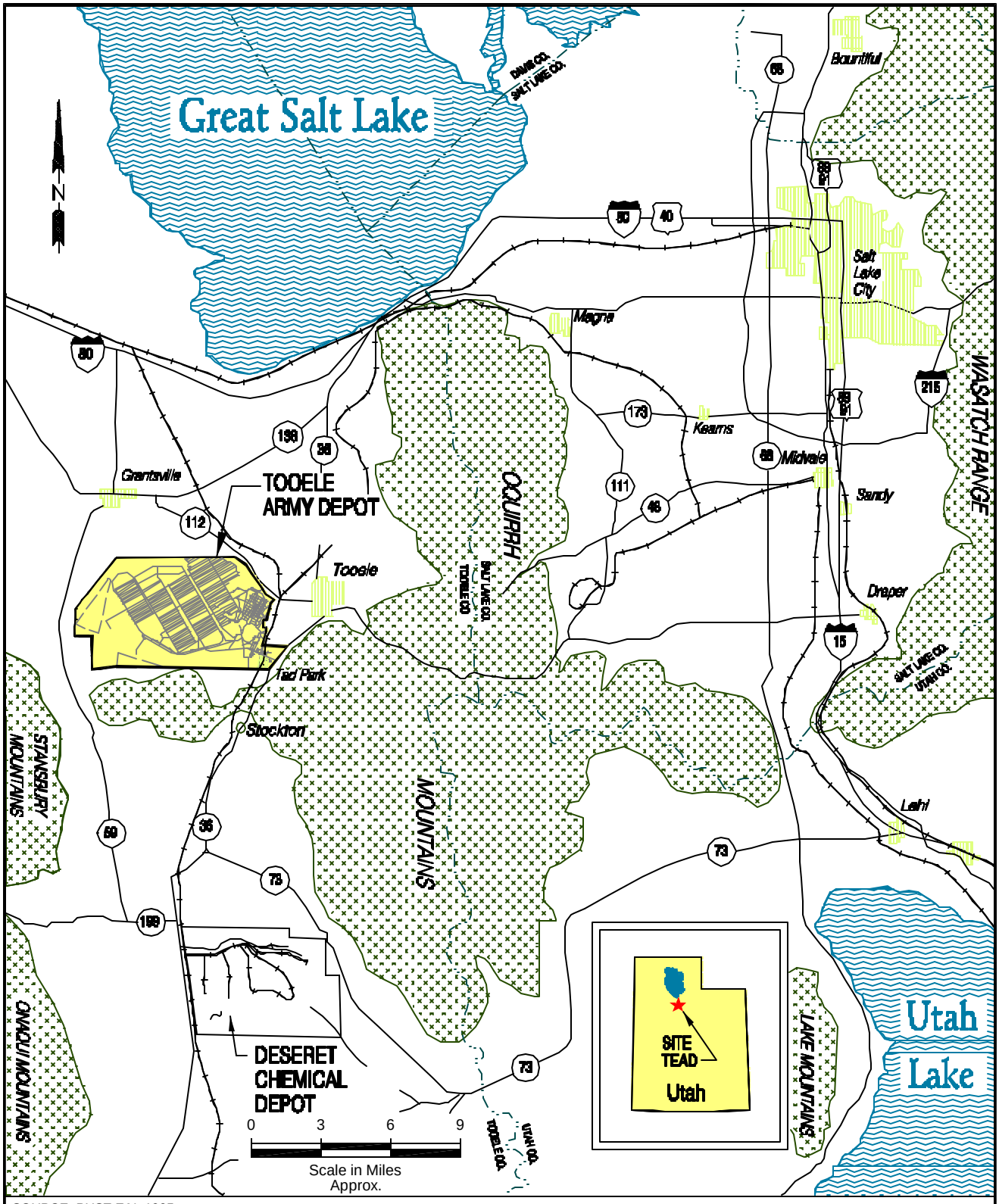
The mission of maintaining and repairing equipment was discontinued in 1995.

Developed features at TEAD include igloos, magazines, administrative buildings, an industrial maintenance area, military and civilian housing, roads, and vehicle storage hardstands and other allied infrastructure. In 1993, TEAD was placed on the list of military facilities scheduled for realignment under the Base Realignment and Closure (BRAC) Program. Of the Group C SWMUs addressed in this report, five (SWMUs 49, 50, 51, 54, and 56) are located within the Maintenance Area, and two (SWMUs 52 and 57) are located within the Administration Area. Both areas were transferred under BRAC in January 1999.

As a result of past activities at the installation, TEAD was included in the U.S. Army's Installation Restoration Program (IRP) in 1978. The first component of that program was an Installation Assessment (U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), 1979), which identified a number of known and potential waste and spill sites and recommended further investigations.

In 1984, TEAD was nominated for inclusion on the National Priorities List (NPL) because of identified hazardous constituents at some sites, particularly the Industrial Waste Lagoon (IWL; SWMU 2). However, TEAD was not placed on the NPL until October 1990. In the interim, the U.S. District Court for the State of Utah issued a consent decree to TEAD for groundwater contamination at SWMU 2.

As part of being placed on the NPL, a Federal Facility Agreement (FFA) was entered into between the U.S. Army, U.S. Environmental Protection Agency (EPA) Region 8, and UDEQ in September 1991. The FFA addresses 17 SWMUs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).



SOURCE: RUST E&I, 1995

FIGURE 1-1
LOCATION MAP OF
TOOELE ARMY DEPOT
AND VICINITY

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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Also in January 1991, TEAD was issued a RCRA Post Closure Permit for the IWL (SWMU 2). The permit included a CAP that required action at 29 SWMUs. Currently, there are 40 SWMUs being addressed under the RCRA CAP, which is regulated by UDEQ.

Since the initial assessment of TEAD, a number of environmental investigations have been performed (and are ongoing) under CERCLA or RCRA. At TEAD, these additional investigations have identified 57 sites, including nine designated as the Group C Suspected Releases SWMUs. These sites are managed under the RCRA CAP program. The Phase II RFI Report (SAIC, 1997) recommended "no further action" for two of these Group C SWMUs (53 and 55) because it concluded that neither posed an unacceptable human health or environmental risk under the future residential land use scenario. However, the Phase II RFI also determined that seven of the Group C SWMUs pose an unacceptable human health risk under the future residential land use scenario. Therefore, according to the UAC R315-101-6(c)3 and EPA guidance (discussed in Section 2 of the CMS Work Plan), a risk-based closure will not be granted, and a site management plan – the requirements of which are met by a CMS – must be prepared.

This CMS Report discusses the following Group C SWMU areas:

- SWMU 49 – Stormwater/Industrial Wastewater Piping
  - Sewer Line – Southern Area
  - Sewer Line – Central Area
  - Sewer Line – Northern Area
  - Building 609
  - B Avenue Outfall
  - G Avenue Outfall
  - H Avenue Outfall
  - J Avenue Outfall
  - K Avenue Outfall.
- SWMU 50 – Compressor Condensate Drains
  - Building 613 Drain
  - Building 619 Drain.
- SWMU 51 – Chromic Acid/Alodine Drying Beds.
- SWMU 52 – Possible Drainfield/Disposal Trenches
  - SWMU 52B – Disposal Trenches
  - SWMU 52C – Charcoal Material Area
  - SWMU 52D – Horse Stable Area.

- SWMU 54 – Sandblast Areas

  - Building 604
  - Building 611
  - Building 637.

- SWMU 56 – Gravel Pit

  - Burned Area
  - Nonburned Area.

- SWMU 57 – Skeet Range.

Figure 1-2 shows the location of these Group C SWMUs evaluated in this CMS Report.

1.3 REPORT ORGANIZATION

The remainder of the CMS Report is organized as follows:

- Section 2.0 describes the evaluation criteria used in the detailed analysis of corrective measures alternatives.

- Sections 3.0 through 9.0 summarize pertinent information presented in the Phase II RFI (SAIC, 1997) and the CMS Work Plan (Dames & Moore, 2001) for SWMUs 49, 50, 51, 52, 54, 56, and 57, respectively. This includes a description of the SWMU; the magnitude and extent of contamination; results of the human health risks and hazards assessment for realistic future uses only; results of the ecological RA; CAOs; COCs; and potentially applicable corrective measures alternatives. Each area-specific corrective measures alternative is evaluated in detail based on the criteria presented in Section 2.0. The alternatives for each SWMU area are then compared, and one is recommended for implementation at each area.

- Section 10.0 summarizes the recommended corrective measures alternatives for each Group C SWMU area.

- Section 11.0 presents the references.

- Appendix A details the costs for each corrective measures alternative.

- Appendix B presents the methodology and results of a post-corrective measures ecological assessment for SWMU 57.

- Appendix C details the costs for corrective measures assuming unrestricted land use.

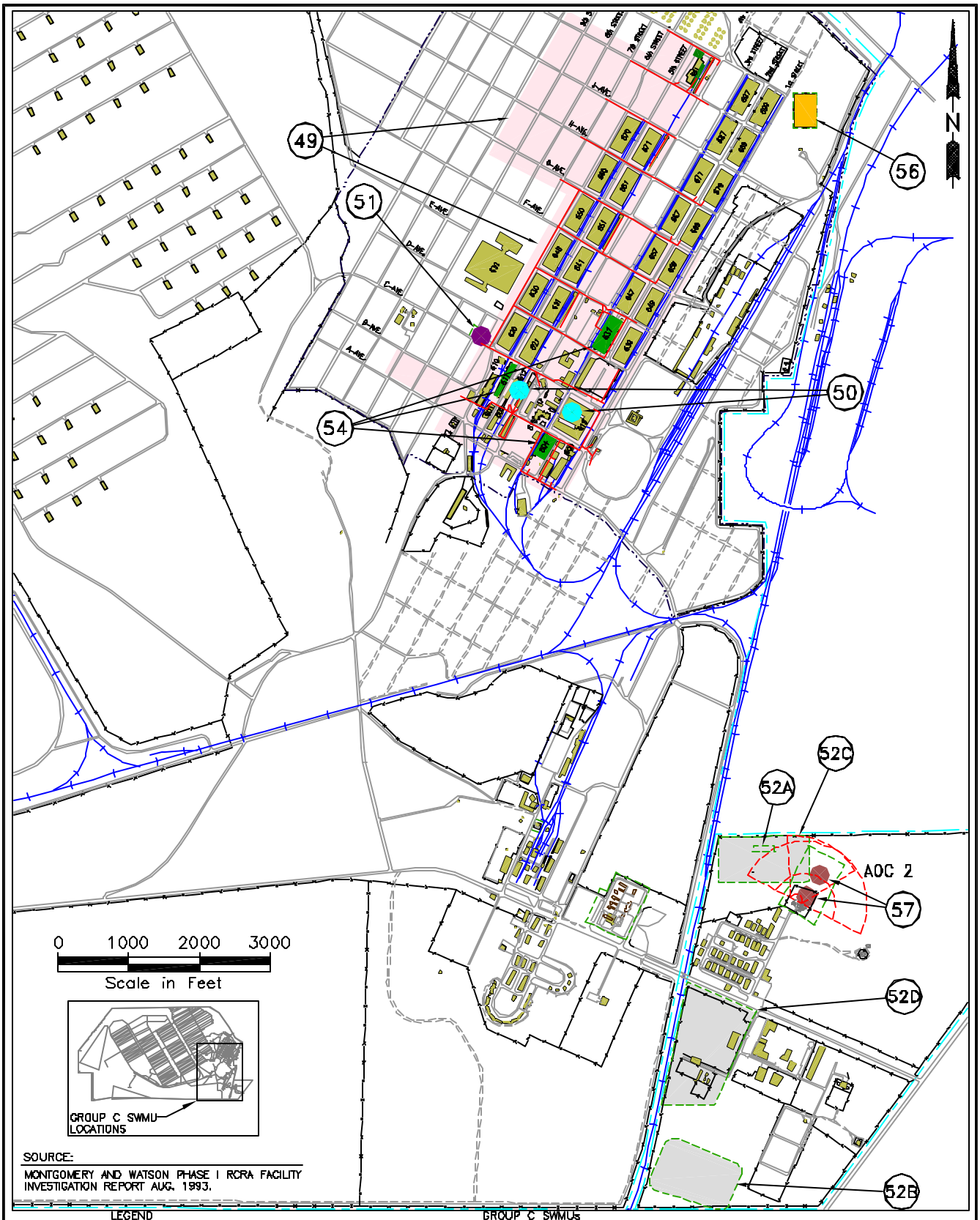

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FIGURE 1-2
LOCATION OF GROUP C
SUSPECTED RELEASE SWMUs
TOOELE ARMY DEPOT

2.0 DESCRIPTION OF EVALUATION CRITERIA

The CMS Work Plan (Dames & Moore, 2001) identifies corrective measures alternatives for the seven Group C SWMUs addressed in this CMS Report. Alternatives are identified by developing CAOs for the contaminants of potential concern (COPCs) in the various media under the assumed future land use scenarios.

The CAOs include quantitative risk-based objectives and qualitative regulatory-driven objectives. They are based on land use and potential receptor assumptions, exposure pathways, results of the human health RA, regulatory criteria, and background sample results. The CAOs for SWMUs 49, 50, 51, 54, and 56 are based on the current and likely future industrial land use scenario; and the CAOs for SWMUs 52 and 57 are based on the likely future residential land use scenario. The CAOs were developed in accordance with UAC R315-101, including the "Principle of Non-Degradation"; EPA guidance (USEPA, 1991); the human health RA for the Group C SWMUs (SAIC, 1997); the Site-Wide Ecological Risk Assessment (SWERA; Rust E&I, 1997); and U.S. Army policy (Radkiewicz, 1995). The COPCs are compared to quantitative CAOs to identify COCs.

To determine which contaminants require action, consideration is given to whether average concentrations across the site (i.e., exposure point concentration (EPC) as used in the RA) exceed the CAO and whether COCs are isolated and at low levels, or whether contaminants present unacceptable ecological risks.

Corrective measures may include management measures or treatment technologies that meet the CAOs and address the COCs; these measures are assembled into corrective measures alternatives. The alternatives are developed according to RCRA guidance on performing a CMS (Sperber, 1996), UAC R315-101, and discussions between the Army, EPA, and UDEQ. The CMS Work Plan explains the methodology in detail. Figure 2-1 summarizes the alternatives development procedure.

RCRA criteria are used to evaluate each of the corrective measures alternatives identified in the CMS Work Plan. In accordance with RCRA guidance on performing a CMS (Sperber, 1996) and Module VII of the RCRA Part B Permit for TEAD, the detailed evaluation of each corrective measures alternative presented in Sections 3.0 to 9.0 considers technical criteria (including performance, reliability, implementability, and safety), protection of human health, protection of the environment, administrative feasibility, and cost, as defined below:

- Technical criteria
  - Performance – Evaluates whether the corrective measures alternative can perform its intended function and meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001), including compliance with Federal,

State, and local regulations. This criterion considers site and waste characteristics, and also the length of time the alternative maintains its intended level of effectiveness.

  - Reliability – Describes the long-term effectiveness and permanence of each alternative. This criterion evaluates the adequacy of the corrective measure based on performance at similar sites, operation and maintenance (O&M) requirements, long-term environmental monitoring needs, and residuals management requirements.

  - Implementability – Assesses the technical and institutional feasibility of executing a corrective measures alternative, including constructability, permit and legal/regulatory requirements, availability of materials, and length of time from implementation to realization of beneficial effects.

  - Safety – Considers the potential threats to workers, nearby communities, and the environment during implementation of the corrective measure.

- Human health assessment – Evaluates the extent to which each alternative protects human health. This criterion considers the classes and concentrations of contaminants left onsite, potential exposure routes, and potentially affected populations. Residual contaminant concentrations are also compared to existing criteria, standards, or guidelines.

- Environmental assessment – Evaluates short- and long-term effects of the corrective measure on the environment, including adverse impacts to environmentally sensitive areas.

- Administrative feasibility – Considers compliance with applicable Federal, State, and local environmental and public health standards, requirements, criteria, or limitations.

- Cost – Considers capital and annual O&M costs for each corrective measures alternative. Capital costs include direct and indirect costs. Annual O&M costs typically include labor, maintenance, energy, and sampling/analysis. For purposes of comparison, costs are presented in terms of present worth (i.e., the current value of a future expenditure). The cost estimates are based on conventional cost estimating guides, vendor information, and engineering judgment. For alternatives with soil excavation and disposal, a preliminary assessment is made concerning whether the soil will be RCRA hazardous as define in 40 CFR Part 261. Appendix A presents the detailed cost estimate tables.

The CMS Report addresses how the alternatives reduce exposure to contamination, contaminant concentration, or contaminant migration.

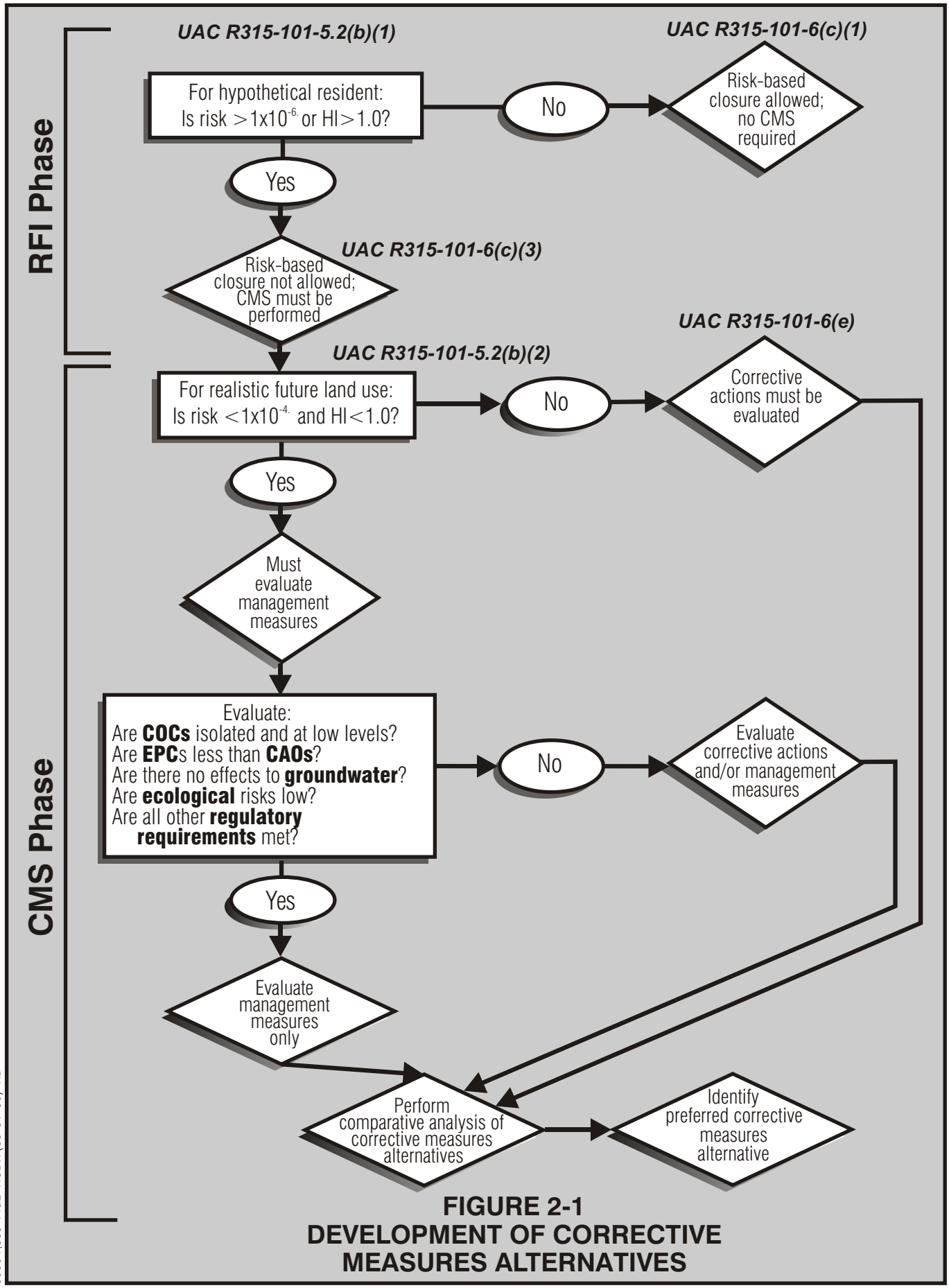


FIGURE 2-1
DEVELOPMENT OF CORRECTIVE MEASURES ALTERNATIVES

09604\056 FIG2-1.CDR (05-31-00) KD

3.0 STORMWATER/INDUSTRIAL WASTEWATER PIPING (SWMU 49)

Section 3.0 evaluates corrective measures alternatives for each of the SWMU 49 areas (Figure 3-1). Data from the CMS Work Plan (Dames & Moore, 2001) and the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 49 is located in an area of the BRAC parcel designated for future industrial use. It consists of the existing underground stormwater system piping and outfalls located throughout the 1,179-acre Maintenance Area of TEAD. The stormwater system – which consists of approximately 15,000 feet of interconnected pipes aligned in a north-south and east-west orientation – also includes manholes, drain systems, and culverts. The main arteries run east-west and are located beneath the lettered streets (A through L Avenues). Secondary pipes run perpendicular to the main arteries and interconnect at road intersections throughout the Maintenance Area. Stormwater is discharged to the ground surface north of the Maintenance Area and dissipates through evaporation and infiltration (SAIC, 1997).

SWMU 49 also includes Building 609, a former steam cleaning/radiator repair facility located in the southeast section of the Maintenance Area. This building produced large amounts of wastewater, which may have affected the stormwater/industrial wastewater system.

From the late 1940s until 1988, when a new industrial wastewater system was installed, SWMU 49 piping carried industrial wastewater effluent to the discharge area north of the Maintenance Area. The buildings in the Maintenance Area were primarily used for activities associated with vehicle maintenance (including reassembly and repair, machining, refurbishing of fuel tanks and radiators, metal degreasing, sandblasting, painting, and forming and shaping of sheet metal). Up to 120,000 gallons of potentially contaminated industrial wastewater was discharged each day; it may have contained acids, caustics, solvents, detergents, oil and grease, and heavy metals.

All activities associated with vehicle maintenance have ceased. All known floor drains and pipes have reportedly been sealed and no longer discharge wastes to the stormwater system (SAIC, 1997).

Because of the large area occupied by the stormwater/industrial wastewater piping, SWMU 49 was evaluated as separate exposure units during the Phase II RFI (SAIC, 1997), as listed below:

- Sewer Line – Southern Area
- Sewer Line – Central Area
- Sewer Line – Northern Area
- Building 609
- B Avenue Outfall

- G Avenue Outfall
- H Avenue Outfall
- J Avenue Outfall
- K Avenue Outfall.

3.1 SEWER LINE – SOUTHERN AREA

3.1.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable hazard indices (HIs) for hypothetical future adult and child residents at the Sewer Line – Southern Area. Therefore, according to EPA guidance (discussed in Section 2 of the CMS Work Plan (Dames & Moore, 2001)) and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. No risks or HIs were calculated for current or future industrial workers because the underground piping system does not affect surface soil.

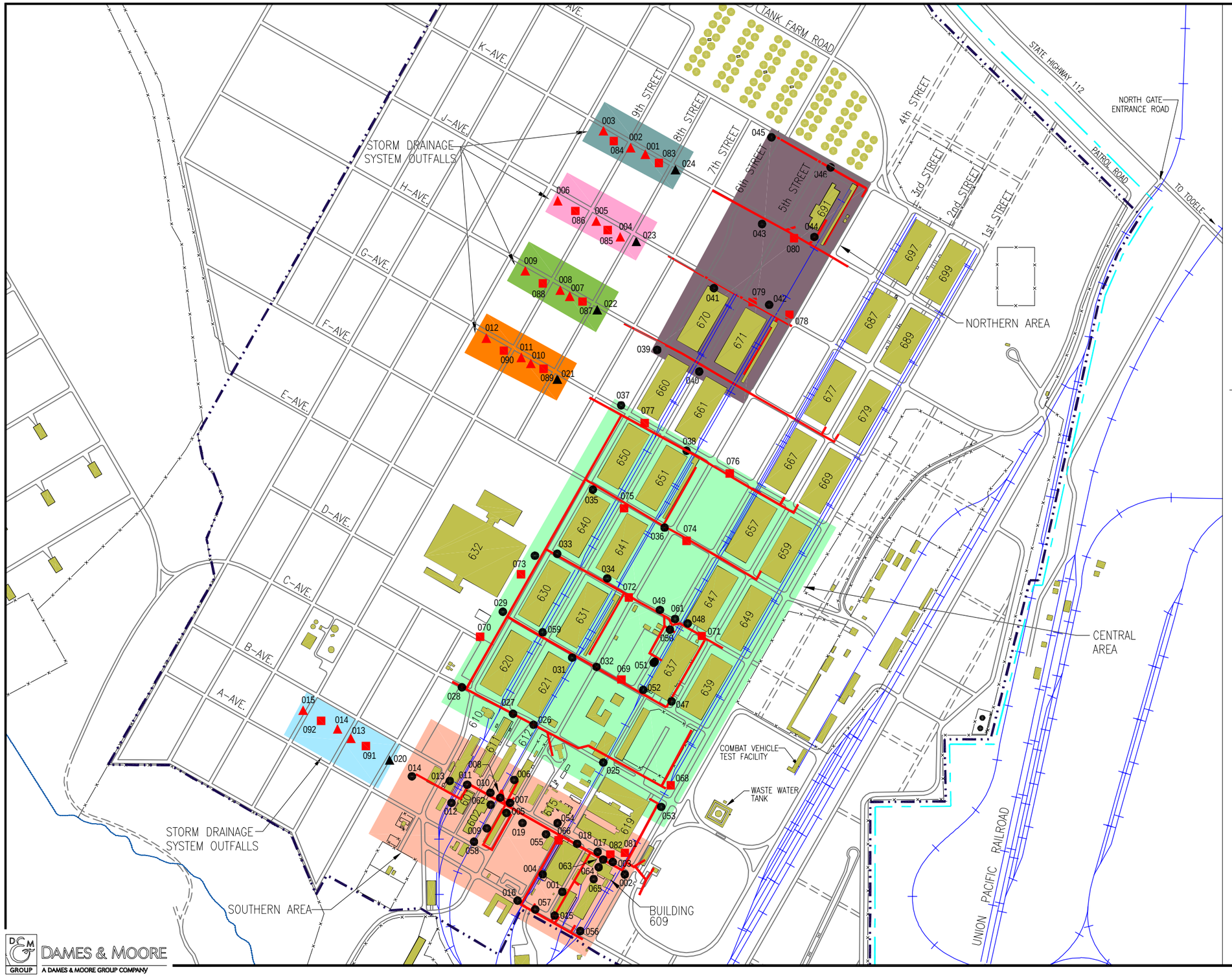
Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater (approximately 300 feet below ground surface (bgs)).

No ecological RA was performed for the Sewer Line – Southern Area because surface soil was not analyzed.

The CMS Work Plan (Dames & Moore, 2001) identified lead as a COC in subsurface soil at one location 7 feet bgs. Although the concentration of lead (4,700 micrograms per gram (µg/g)) in this one sample exceeds its CAO (1,800 µg/g), the exposure point concentration (EPC) for lead at the site is 48.8 µg/g – which is below the EPA-recommended screening level of 400 µg/g (USEPA, 1994a) and well below the CAO. (As described in the human health RA (SAIC, 1997), the EPC represents the concentration that an individual would likely be exposed to while working.) However, corrective action for removal of the soil at the identified lead COC location is considered along with management measures.

The CMS Work Plan estimated the extent of contamination at the Sewer Line-Southern Area, as shown on Figure 3-2. Based on the single lead COC location, the estimated extent of soil contamination is approximately 100 square feet (ft^2). The depth of contaminated soil is assumed to be 9 feet. The total volume of lead contaminated soil is approximately 33 cubic yards (yd^3). The actual areas and depths of contamination will be determined by confirmatory sampling during the corrective measure.

The CAOs for the Sewer Line – Southern Area are:



LEGEND

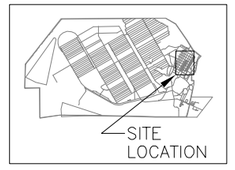
- BUILDING
- RAILROAD
- FENCE
- BRAC PARCEL BOUNDARY
- TEAD BOUNDARY
- UNDERGROUND STORMWATER PIPING
- OUTFALL SEDIMENT, SURFACE WATER, AND SOIL BORING LOCATION
- PHASE I SOIL BORING
- PHASE II SOIL BORING
- PHASE II SURFACE SOIL SAMPLE

SWMU BOUNDARIES

- K–AVENUE OUTFALL
- B–AVENUE OUTFALL
- J–AVENUE OUTFALL
- NORTHERN AREA
- H–AVENUE OUTFALL
- CENTRAL AREA
- G–AVENUE OUTFALL
- SOUTHERN AREA

NOTE:

1. UNDERGROUND STORMWATER PIPING AND OVERLAND STORMWATER PIPING DIGITIZED FROM FAX COPIES OF MAPS PROVIDED BY SAIC, McLEAN, NOVEMBER 4, 1994.
2. SWMU 49 – OLD PIPING CONNECTIONS AT BUILDINGS 600, 601, 602, 606, 609, 610, 611, 612, 615, 620, AND 637.
3. STEAM CLEANING/RADIATOR REPAIR FACILITY BUILDING 609.



N

0 400 800 1600

SCALE: 1" = 800'

FIGURE 3-1
STORMWATER/INDUSTRIAL WASTEWATER PIPING (SWMU 49) EXPOSURE UNITS
TOOELE ARMY DEPOT

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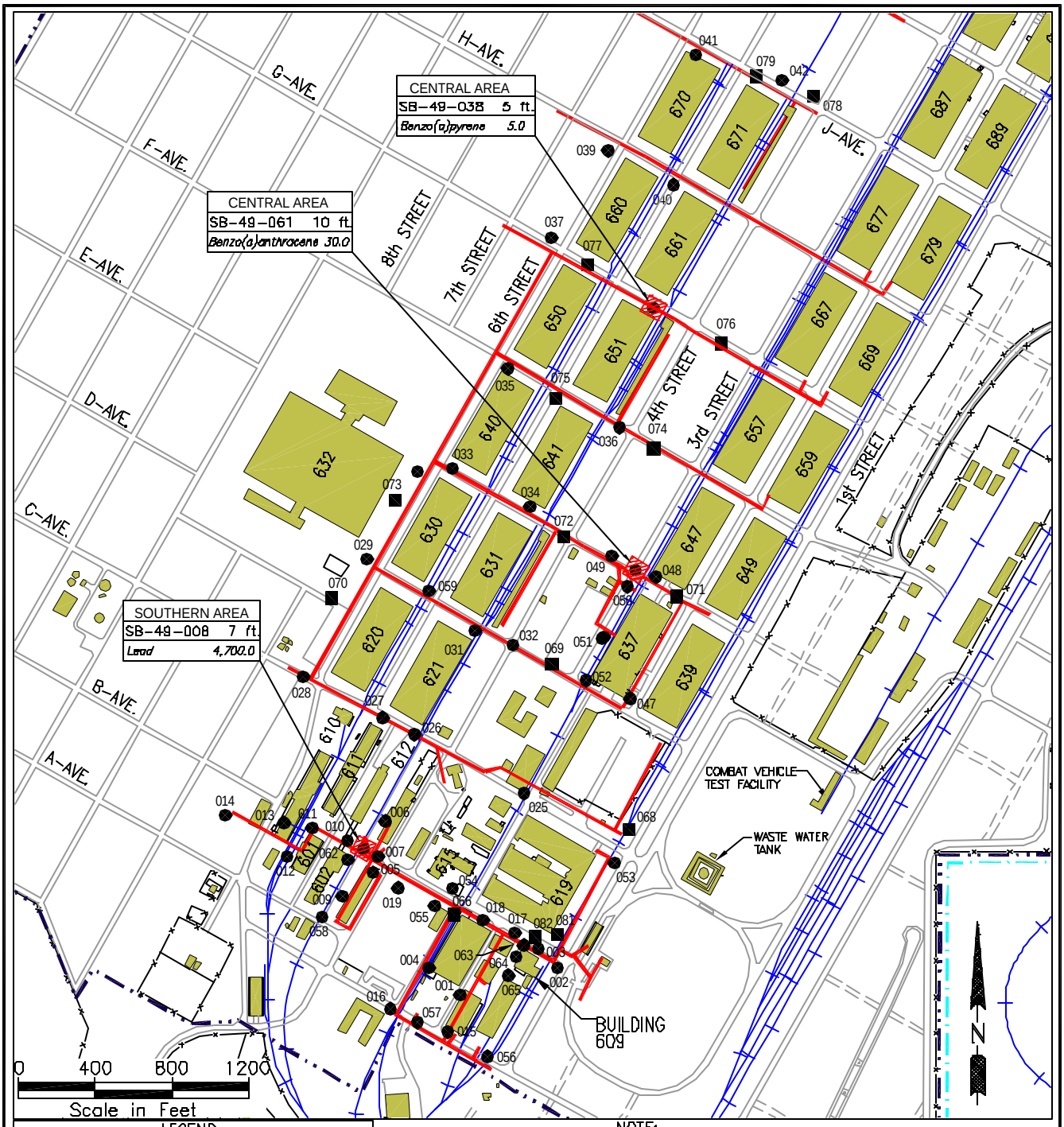
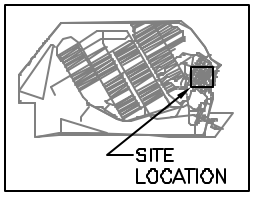


LEGEND

- BUILDING
- RAILROAD
- FENCE
- BRAC PARCEL BOUNDARY
- TEAD BOUNDARY
- UNDERGROUND STORMWATER PIPING
- PHASE I SOIL BORING
- PHASE II SOIL BORING
- APPROXIMATE AREA OF CONTAMINATION

CONCENTRATIONS IN ug/g SOURCE: SAIC, 1997



NOTE:

1. UNDERGROUND STORMWATER PIPING AND OVERLAND STORMWATER PIPING DIGITIZED FROM FAX COPIES OF MAPS PROVIDED BY SAIC, McLEAN, NOVEMBER 4, 1994.
2. SWMU 49 – OLD PIPING CONNECTIONS AT BUILDINGS 600, 601, 602, 606, 609, 610, 611, 612, 615, 620, AND 637.
3. STEAM CLEANING/RADIATOR REPAIR FACILITY BUILDING 609.

ESTIMATED AREA OF CONTAMINATION FOR ALL THREE COC LOCATIONS IS 100 SQ. FEET (NOT SHOWN TO SCALE)

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FIGURE 3-2
COC LOCATIONS AND APPROXIMATE AREA OF CONTAMINATION AT THE STORMWATER/INDUSTRIAL WASTEWATER PIPING (SWMU 49) SEWER LINE SOUTHERN AND CENTRAL AREA TOOELE ARMY DEPOT

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment, regulatory requirements, and the small volume of contaminated soil, two corrective measure alternatives are evaluated for the Sewer Line – Southern Area at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternatives for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.
Alternative 2: Excavation, off-post treatment/disposal, and deed restrictions
Excavate contaminated soil. Fill and compact with clean soil. Characterize, transport, and treat/dispose of contaminated soil off post in accordance with U.S. Army protocols and State and Federal regulations Impose deed restrictions to prevent residential development.

Table 3-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Sewer Line – Southern Area in the CMS Work Plan (Dames & Moore, 2001).

3.1.2 Detailed Evaluation of Corrective Measures Alternatives

Section 3.1.2 evaluates the two corrective measures alternatives for the Sewer Line – Southern Area.

3.1.2.1 Alternative 1 – Deed Restrictions. Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November, 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, The State of Utah Department of Environmental Quality, and the

TABLE 3-1

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, Sewer Line – Southern Area (SWMU 49)

Phase II RFI (SAIC, 1997)										CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Residential Land Use Scenario (c)				Realistic Future Land Use Scenario (d)				None	NE	Subsurface soil: Lead (h)	***Deed restrictions*** Excavation, off-post treatment/disposal, and deed restrictions
	Risk	HI	Blood Lead Level (e)		Risk	HI	Blood Lead Level (e)				
Adult	4×10^{-7}	**200**	NE (f)	Industrial	NA (g)	NA	NE				
Child	2×10^{-7}	**400**	NE	Construction	8×10^{-11}	0.04	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 micrograms per deciliter (µg/dL), respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The Centers for Disease Control and Prevention (CDC) define a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Not applicable; risks and HIs are not calculated because industrial workers are exposed to surface soil only, and the stormwater/industrial wastewater piping is underground.
(h) Lead was detected at concentrations above CAOs in only one sample. The lead exposure point concentration (EPC) is well below the CAO.

U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December, 1998).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential use of the Sewer Line – Southern Area at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No operation and maintenance (O&M), management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Deed restrictions protect human health by preventing residential exposure to the previously identified contaminants in subsurface soil.
- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the Sewer Line – Southern Area.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-1 (Appendix A) presents the detailed cost estimate.

3.1.2.2 Alternative 2 – Excavation, Off-post Treatment/Disposal, and Deed Restrictions. Alternative 2 includes the excavation of approximately 33 yd^3 of contaminated soil to an approximate depth of 9 feet bgs. Confirmatory soil samples are collected from the floor and each sidewall, and analyzed for lead. Excavation and confirmatory sampling continue until the quantitative CAO for lead is achieved.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 49 suggest that the lead in soil is not a listed waste. However, the contaminant data suggests that lead will exceed TCLP regulatory levels and the soil will therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, Department of Transportation (DOT)) and additional testing (e.g., Toxicity characteristic leaching procedure (TCLP)) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet RCRA land disposal restrictions (LDR) guidelines), or to a treatment, storage, and disposal facility (TSDF) for treatment prior to disposal (as decided by the TSDF based on available resources and costs). The excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D nonhazardous waste landfill for disposal.

For purposes of the corrective action cost estimate, it is assumed that the excavated soil is hazardous and is treated and disposed at a TSDF. Clean soil from an on-post borrow site is backfilled into excavated areas. A gravel or asphalt cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 1 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary

presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 2 – excavation, off-post treatment/disposal and deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, off-post treatment/disposal, and deed restrictions meet the CAOs for the Sewer Line – Southern Area developed in the CMS Work Plan (Dames & Moore, 2001). Off-post treatment/disposal reduces the toxicity and mobility of contaminants. This alternative also complies with UAC R315-101-3, the "Principle of Non-Degradation," by removing contaminated soil from the site. Deed restrictions limit future exposure by preventing residential use of the Sewer Line – Southern Area at SWMU 49. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal. Deed restrictions are effective over the long term and have been implemented at many sites with positive results. No additional exposure should occur while the restrictions are in place (see Appendix B, Section B.2.1 of the CMS Work Plan).

  – Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle C landfill and a TSDF are located within 100 miles of TEAD. Excavating soil to a depth of approximately 9 feet bgs and in the immediate vicinity of the sewer line will hamper excavation activities. Shoring will also be necessary. Required equipment and materials are readily available. To meets CAOs, approximately one week is required for excavation, off-post transportation/disposal, and backfilling. Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

  – Safety – Excavation and off-post treatment/disposal of surface soil pose minimal threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to contaminated soil. Restricting future development of the site also protects human health by preventing residential exposure to the previously identified contaminants in surface soil. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

- Environmental assessment – This alternative has no effects on the ecological environment surrounding the Sewer Line – Southern Area.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $47,000. Table A-2 (Appendix A) presents the detailed cost estimate.

3.1.3 Comparative Analysis Of Corrective Measures Alternatives

Table 3-2 and the text below summarize the comparative analysis of the two corrective measures alternatives developed for the Sewer Line – Southern Area (SWMU 49).

- Technical criteria

  – Performance – Both Alternative 1 (deed restrictions) and Alternative 2 (excavation, off-post treatment/disposal, and deed restrictions) are rated high with respect to performance. Both Alternatives meet the CAOs.

  – Reliability – Alternatives 1 and 2 are rated high for reliability. Each alternative has been proven effective at other sites and does not require onsite O&M activities – though O&M and long-term monitoring are required at the off-post landfills.

  – Implementability – Alternative 1 is easy to implement and is rated high. Alternative 2 is rated moderate because although equipment and contractors for excavation and removal are readily available, the presence of the sewer line will hamper excavation activities. Shoring will also be necessary.

  – Safety – Alternative 1 is rated high because no intrusive activities are required. Alternative 2 is rated moderate because it requires handling of

TABLE 3-2

Comparative Analysis of Corrective Measures Alternatives
Sewer Line – Southern Area (SWMU 49) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost (b)
	Performance	Reliability	Implementability	Safety				
1. Deed restrictions	High	High	High	High	High	High	High	$12,000
2. Excavation, off-post treatment/disposal, and deed restrictions	High	High	Moderate	Moderate	High	High	High	$47,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

contaminated soil and transporting the soil offsite for treatment/disposal. It presents short-term exposure to both onsite workers and offsite residential communities.

- Human health assessment – Both alternatives are rated high because they protect human health by preventing residential exposure to the identified contaminants. Alternative 2 also removes soil with lead above its CAO. However, the EPC for lead is well below its CAO and so Alternative 1 is also protective of industrial and construction receptors. In addition, the COC is 7 feet bgs so exposure will only occur if the subsurface soil is excavated.

- Environmental assessment – Both alternatives are rated high because they have no effects on the ecological environment surrounding the Sewer Line – Southern Area.

- Administrative feasibility – Both Alternatives 1 and 2 are rated high. Both alternatives meet the requirements of UAC R315-101 but require deed restrictions.

- Cost – Of the two alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $12,000. The cost for Alternative 2 is estimated at $47,000.

3.1.4 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Sewer Line – Southern Area at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.2 SEWER LINE – CENTRAL AREA

3.2.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the Sewer Line – Central Area. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. No risks or HIs were calculated for current or future industrial workers because the underground piping system does not affect surface soil.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Specifically, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

No ecological RA was performed for the Sewer Line – Central Area because surface soil was not analyzed.

The CMS Work Plan (Dames & Moore, 2001) identified benzo(a)anthracene and benzo(a)pyrene as COCs in subsurface soil. Each COC was detected at concentrations only slightly greater that its CAO and at two locations only. The EPCs for both PAHs are below their corresponding CAOs. However, corrective action for removal of the soil around the identified COC locations is considered along with management measures.

The CMS Work Plan estimated the extent of contamination at the Sewer Line-Central Area, as shown on Figure 3-2. Based on the two PAH COC locations, the estimated extent of soil contamination is approximately 200 ft^2. The depth of contaminated soil at the two COC locations are assumed to be 6 and 11 feet. The total volume of PAH contaminated soil is approximately 63 yd^3. The actual areas and depths of contamination will be determined by confirmatory sampling during the corrective measure.

The CAOs for the Sewer Line – Central Area are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment, regulatory requirements, and the small volume of contaminated soil, only two corrective measure alternatives are evaluated for the Sewer Line – Central Area at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternatives for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.
Alternative 2: Excavation, off-post treatment/disposal, and deed restrictions
Excavate contaminated soil. Fill and compact with clean soil. Characterize, transport, and treat/dispose of contaminated soil off post in accordance with U.S. Army protocols and State and Federal regulations. Impose deed restrictions to prevent residential development.

Table 3-3 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Sewer Line – Central Area in the CMS Work Plan (Dames & Moore, 2001).

3.2.2 Detailed Evaluation of Corrective Measures Alternatives

Section 3.2.2 evaluates the two corrective measures alternatives for the Sewer Line – Central Area.

3.2.2.1 Alternative 1 – Deed Restrictions. Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of the Sewer Line – Central Area at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should

TABLE 3-3

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, Sewer Line – Central Area (SWMU 49)

Phase II RFI (SAIC, 1997)										**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	NE	Subsurface soil: Benzo(a)anthracene (h) Benzo(a)pyrene (h)	***Deed restrictions*** Excavation, off-post treatment/disposal, and deed restrictions
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**1×10^{-4}**	0.09	NE (f)	Industrial	NA (g)	NA	NE				
Child	**6×10^{-5}**	0.3	NE	Construction	2×10^{-6}	0.0006	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Not applicable; risks and HIs are not calculated because industrial workers are exposed to surface soil only, and the stormwater/industrial wastewater piping is underground.
(h) Benzo(a)anthracene and benzo(a)pyrene were detected at concentrations only slightly above CAOs and in isolated locations.

occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

- Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

- Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to the previously identified contaminants in subsurface soil.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the Sewer Line – Central Area.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-3 (Appendix A) presents the detailed cost estimate.

3.2.2.2 Alternative 2 – Excavation, Off-post Treatment/Disposal, and Deed Restrictions. Alternative 2 includes the excavation of approximately 63 yd^3 of contaminated soil to an approximate depth of 6 feet at one hot spot and 11 feet at the other hot spot. Confirmatory soil samples are collected from the floor and each sidewall, and analyzed for benzo(a)anthracene and benzo(a)pyrene. Excavation and confirmatory sampling continue until the quantitative CAOs for these contaminants are achieved.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 49 suggest that the COCs are not listed wastes. A review of the contaminant data also suggest that the soil will not exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) may be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal (as decided by the TSDF based on available resources and costs). The excavated

material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D nonhazardous waste landfill for disposal.

For purposes of the corrective action cost estimate, it is assumed that the excavated soil is not hazardous and can be disposed in a Subtitle D landfill. Clean soil from an on-post borrow site is backfilled into excavated areas. A gravel or asphalt cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 1 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 2 – excavation, off-post treatment/disposal and deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, off-post treatment/disposal, and deed restrictions meet the CAOs for the Sewer Line – Central Area developed in the CMS Work Plan (Dames & Moore, 2001). Off-post treatment/disposal reduces the toxicity and mobility of contaminants. This alternative also complies with UAC R315-101-3, the "Principle of Non-Degradation," by removing contaminated soil from the site. Deed restrictions limit future exposure by preventing residential use of the Sewer Line – Central Area at SWMU 49. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal. Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place.

- Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle D landfill and a TSDF are located within 100 miles of TEAD. Excavating soil to a depth of approximately 8 to 12 feet and in the immediate vicinity of the sewer line will hamper excavation activities. Shoring will also be necessary. Required equipment and materials are readily available. To meets CAOs, approximately one week is required for excavation, off-post transportation/disposal, and backfilling. Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

- Safety – Excavation and off-post treatment/disposal of surface soil pose minimal threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to contaminated soil. Restricting future development of the site also protects human health by preventing residential exposure to the previously identified contaminants in surface soil. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

- Environmental assessment – This alternative has no effects on the ecological environment surrounding the Sewer Line – Central Area.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $52,000. Table A-4 (Appendix A) presents the detailed cost estimate.

3.2.3 Comparative Analysis Of Corrective Measures Alternatives

Table 3-4 and the text below summarize the comparative analysis of the two corrective measures alternatives developed for the Sewer Line – Central Area (SWMU 49).

- Technical criteria

TABLE 3-4

Comparative Analysis of Corrective Measures Alternatives
Sewer Line – Central Area (SWMU 49) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost (b)
	Performance	Reliability	Implementability	Safety				
1. Deed restrictions	High	High	High	High	High	High	High	$12,000
2. Excavation, off-post treatment/disposal, and deed restrictions	High	High	Moderate	Moderate	High	High	High	$52,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

- Performance – Both Alternative 1 (deed restrictions) and Alternative 2 (excavation, off-post treatment/disposal, and deed restrictions) are rated high with respect to performance. Both Alternatives meet the CAOs.

- Reliability – Alternatives 1 and 2 are rated high for reliability. Each alternative has been proven effective at other sites and does not require onsite O&M activities – though O&M and long-term monitoring are required at the off-post landfills.

- Implementability – Alternative 1 is easy to implement, and is rated high. Alternative 2 is rated moderate because although equipment and contractors for excavation and removal are readily available, the presence of the sewer line will hamper excavation activities. Shoring will also be necessary.

- Safety – Alternative 1 is rated high because no intrusive activities are required. Alternative 2 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for treatment/disposal. It presents short-term exposure to both onsite workers and offsite residential communities.

- Human health assessment – Both Alternatives 1 and 2 are rated high because they protect human health by preventing residential exposure to the identified contaminants. Alternative 2 also removes soil with PAHs above their CAOs. However, the EPCs for the PAHs are well below their CAOs and so Alternative 1 is also protective of industrial and construction receptors. In addition, the COCs are 6 and 11 feet bgs so exposure will only occur if the subsurface soil is excavated.

- Environmental assessment – Both alternatives are rated high because they have no effects on the ecological environment surrounding the Sewer Line – Central Area.

- Administrative feasibility – Both Alternatives 1 and 2 are rated high. Both alternatives meet the requirements of UAC R315-101 but require deed restrictions.

- Cost – Of the two alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $12,000. The cost for Alternative 2 is estimated at $52,000.

3.2.4 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Sewer Line – Central Area at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.3 SEWER LINE – NORTHERN AREA

3.3.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the Sewer Line – Northern Area. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. No risks or HIs were calculated for current or future industrial workers because the underground piping system does not affect surface soil.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

No ecological RA was performed for the Sewer Line – Northern Area because surface soil was not analyzed.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at this area of SWMU 49.

The CAOs for the Sewer Line – Northern Area are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the Sewer Line – Northern Area at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 3-5 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Sewer Line – Northern Area in the CMS Work Plan (Dames & Moore, 2001).

3.3.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential use of the Sewer Line – Northern Area at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.
- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the Sewer Line – Northern Area.
- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

TABLE 3-5

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, Sewer Line – Northern Area (SWMU 49)

Phase II RFI (SAIC, 1997)									**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	NE	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**4×10^{-6}**	**400**	NE (f)	Industrial	NA (g)	NA	NE				
Child	**3×10^{-6}**	**1,000**	NE	Construction	5×10^{-8}	0.1	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Not applicable; risks and HIs are not calculated because industrial workers are exposed to surface soil only, and the stormwater/industrial wastewater piping is underground.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-5 (Appendix A) presents the detailed cost estimate.

3.3.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Sewer Line – Northern Area at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.4 BUILDING 609

3.4.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable HIs for hypothetical future adult and child residents at Building 609. Therefore, according to EPA guidelines and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. No unacceptable risks or HIs were identified for current or future industrial workers, or for future construction workers.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and to continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife. In the Phase II RFI (SAIC, 1997), Building 609 was screened from a detailed ecological RA because of no suitable habitat.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at Building 609. A review of the human health RA conducted in the RFI (SAIC, 1997) indicates that thallium drives a noncancer residential health risk via the food ingestion pathway. Thallium is detected at one surface sample at a concentration is 22.6 µg/g, which is below comprehensive basewide background level of 54 µg/g. Therefore, no corrective measures are recommended for this site.

Table 3-6 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997). No action is recommended at Building 609 of SWMU 49 because there are no unacceptable risks or hazards. No action does not mitigate potential residential risk at the site because it provides no additional protection of human health

TABLE 3-6

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, Building 609 (SWMU 49)

Phase II RFI (SAIC, 1997)										CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Residential Land Use Scenario (c)				Realistic Future Land Use Scenario (d)				None	Low	None	***No action***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	NA (f)	**100 (g)**	NE (h)	Industrial	NA	0.4	NE				
Child	NA	**300 (g)**	NE	Construction	NA	0.03	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) Not applicable; cancer risks are not quantified because none of the COPCs has a toxicity value for carcinogenic effects.
(g) Elevated HIs due to thallium in soil at a concentration below the comprehensive basewide background level.
(h) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

beyond current conditions and allows residual risk to remain onsite. However, the primary contributor to the residential risk is thallium in surface soil at a maximum concentration of 22.6 µg/g. This maximum concentration is below the 54 µg/g background concentration for thallium based on the comprehensive background data set. Therefore, residual risks under the no action alternative do not exist. No unacceptable ecological risks or impacts to the environment were identified at Building 609.

3.5 B AVENUE OUTFALL

3.5.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the B Avenue Outfall. In addition, the 95 percentile blood lead level for children exceeded the Centers for Disease Control and Prevention (CDC) guideline of 10 micrograms per deciliter (µg/dL). Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil and sediment (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and to continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife. Although the Phase II RFI (SAIC, 1997) identified potential moderate ecological risks based on vegetation HQ levels, a high degree of uncertainty is associated with the plant risks due to limited toxicological information. Furthermore, most plant toxicity studies are conducted on vegetation that would not survive in the desert environment, such as typical agricultural crops (e.g., lettuce, wheat, and rice). The estimated risks to plants at the B Avenue Outfall, as indicated by higher HIs, are highly uncertain because of the physiochemical differences (i.e., high clay content, high native mineral content) in arid desert soil at TEAD compared to soil from wetter climates, as well as species differences. The SWERA concluded there is no ecological habitat at this SWMU and rated the ecological risk as low. Based on the conclusions of both reports the potential ecological risk at this area of SWMU 49 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at the B Avenue Outfall.

The CAOs for the B Avenue Outfall are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the B Avenue Outfall at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 3-7 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the B Avenue Outfall in the CMS Work Plan (Dames & Moore, 2001).

3.5.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of the B Avenue Outfall at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results. No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

  – Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the

TABLE 3-7

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, B Avenue Outfall (SWMU 49)

Phase II RFI (SAIC, 1997)										**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**4×10^{-6}**	**2**	NE (f)	Industrial	5×10^{-7}	0.1	5.8				
Child	**3×10^{-6}**	**6**	**11.5**	Construction	5×10^{-8}	0.04	8.0				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC define a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

– Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the B Avenue Outfall.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-6 (Appendix A) presents the detailed cost estimate.

3.5.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the B Avenue Outfall at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.6 G AVENUE OUTFALL

3.6.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the G Avenue Outfall. Therefore, according to EPA guidelines and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

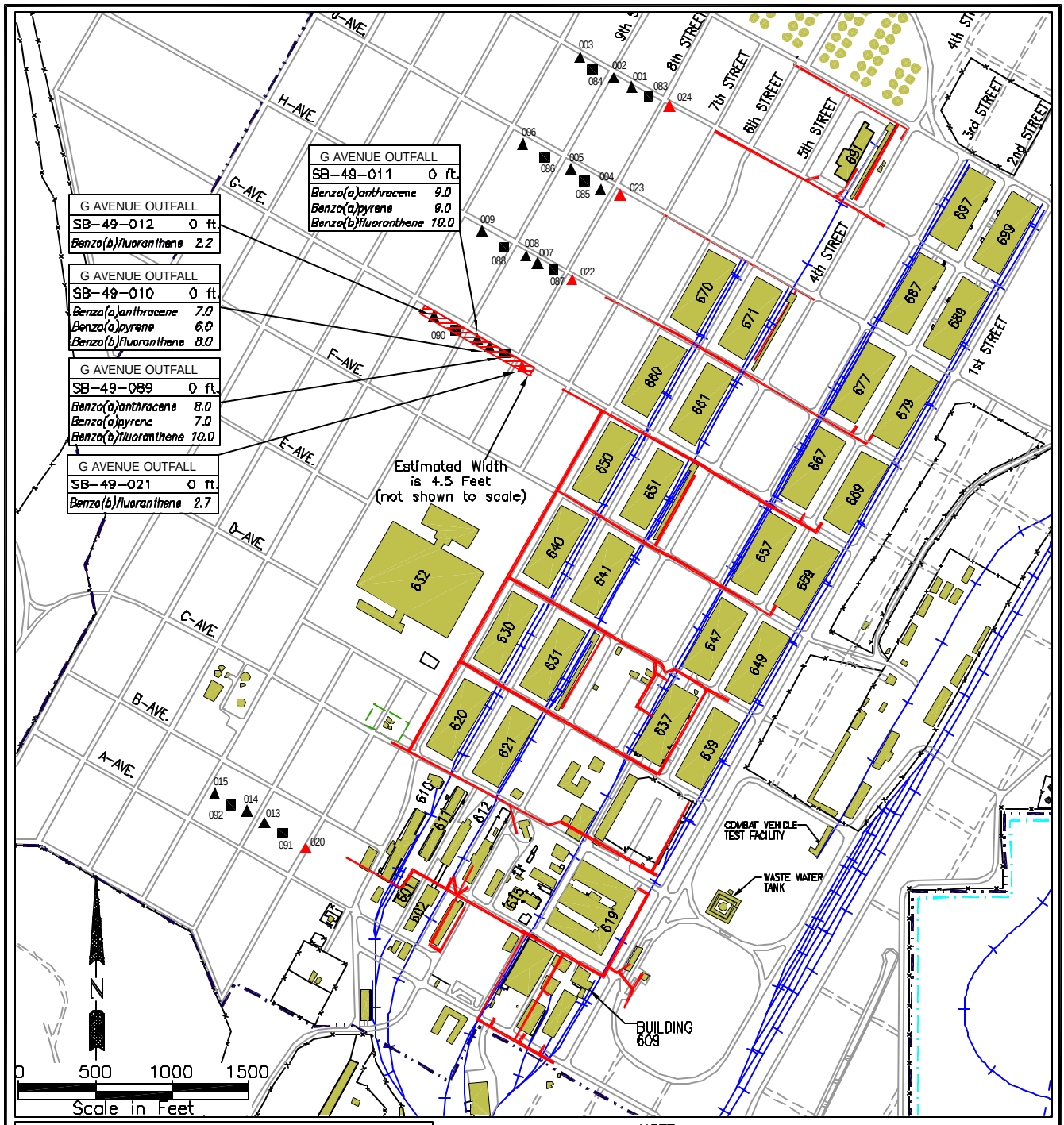
Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and to continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife.

Although the Phase II RFI (SAIC, 1997) identified potential moderate ecological risks based on vegetation levels, a high degree of uncertainty is associated with the plant risks due to limited toxicological information. Furthermore, most plant toxicity studies are conducted on vegetation that would not survive in the desert environment, such as typical agricultural crops (e.g., lettuce, wheat, and rice). The estimated risks to plants at the G Avenue Outfall, as indicated by higher HIs, are highly uncertain because of the physiochemical differences (i.e., high clay content, high native mineral content) in arid desert soil at TEAD compared to soil from wetter climates, as well as species differences. The SWERA concluded that there is no ecological habitat at this SWMU and rated the ecological risk as low. Based on the conclusions of both reports the potential ecological risk at this area of SWMU 49 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

The CMS Work Plan (Dames & Moore, 2001) identified COCs by comparing the maximum concentration of each COPC identified in the Phase II RFI Report (SAIC, 1997) to the respective quantitative CAO. Using industrial use CAOs, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were identified as COCs in surface soil at the G Avenue Outfall. The EPCs for each of the three compounds also exceed their respective CAOs. The EPCs for benzo(a)anthracene and benzo(b)fluoranthene are approximately four times their respective CAOs while the EPC for benzo(a)pyrene is approximately 50 times its CAO. Because the CAO values correspond to a cancer risk of 1×10^{-6}, the EPC concentrations for these contaminants do not result in an unacceptable risk. These compounds presumably originate from stormwater runoff from the Maintenance Area; they are commonly associated with runoff from asphalt and parking lots. Concentrations exceed CAOs for these three polycyclic aromatic hydrocarbons (PAHs) in five out of six surface soil samples along the outfall. However, because PAH levels are higher than other outfalls and their presence at ground surface, corrective action is considered for this area of SWMU 49.

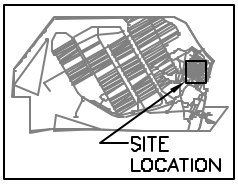
The CMS Work Plan estimated the extent of contamination at the G Avenue Outfall, as shown on Figure 3-3. COC locations used to define the areas and volumes of contaminated soil are illustrated in Figure 3-3. Based on the soil sampling data presented in detail in the Phase II RFI (SAIC, 1997), the contaminated soil is assumed to extend to an average depth of 1 foot bgs for the PAH-contaminated area. The total area containing soil contaminated with PAHs is estimated to be 3,600 ft^2. The total volume of PAH contaminated soil is approximately 135 yd^3, respectively. The actual areas and depths of contamination will be determined by confirmatory sampling to be conducted when the selected corrective measure is implemented.



LEGEND

- BUILDING
- RAILROAD
- FENCE
- BRAC PARCEL BOUNDARY
- TEAD BOUNDARY
- UNDERGROUND STORMWATER PIPING
- SEDIMENT, SURFACE WATER AND SOIL BORING
- PHASE II OUTFALL SURFACE SOIL SAMPLE
- PHASE II SOIL BORING
- APPROXIMATE AREA OF CONTAMINATION

CONCENTRATIONS IN ug/g SOURCE: SAIC, 1997.



NOTE:

1. UNDERGROUND STORMWATER PIPING AND OVERLAND STORMWATER PIPING DIGITIZED FROM FAX COPIES OF MAPS PROVIDED BY SAIC, McLEAN, NOVEMBER 4, 1994.
2. SWMU 49 - OLD PIPING CONNECTIONS AT BUILDINGS 600, 601, 602, 606, 609, 610, 611, 612, 615, AND 637.

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FIGURE 3-3
COC LOCATIONS AND APPROXIMATE AREA OF CONTAMINATION AT THE STORMWATER/INDUSTRIAL WASTEWATER PIPING (SWMU 49) G AVENUE OUTFALL
TOOELE ARMY DEPOT

In addition to the previously discussed quantitative CAOs based on future industrial use of the site, the CMS Work Plan (Dames & Moore, 2001) presented qualitative CAOs for the G Avenue Outfall to comply with UAC R315-101, as follows:

- To protect other media from further degradation (i.e., to ensure that levels of contamination do not increase beyond existing levels, per UAC R315-101-3).

- To comply with UAC R315-101 and all its parts.

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

Based on the evaluation of risks and hazards to human health and the environment, regulatory requirements, and the small volume of contaminated soil, only two corrective measures alternatives are evaluated for the G Avenue Outfall at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternatives for this area:

Alternative 1: Deed Restrictions
Impose deed restrictions to prevent residential development.
Alternative 1: Excavation, off-post treatment/disposal, and deed restrictions
Excavate contaminated soil. Fill and compact with clean soil. Characterize, transport, and treat/dispose of contaminated soil off post in accordance with U.S. Army protocols and State and Federal regulations Reconstruct outfall. Impose deed restrictions to prevent residential development.

Table 3-8 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the G Avenue Outfall in the CMS Work Plan (Dames & Moore, 2001).

3.6.2 Detailed Evaluation of Corrective Measures Alternatives

Section 3.6.2 evaluates the two corrective measures alternatives for the G Avenue Outfall.

3.6.2.1 Alternative 1 – Deed Restrictions. Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply

TABLE 3-8

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, G Avenue Outfall (SWMU 49)

Phase II RFI (SAIC, 1997)										**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	Surface soil: Benzo(a)anthracene (g) Benzo(a)pyrene (g) Benzo(b)fluoranthene (g)	Deed restrictions ***Excavation, off-post treatment/disposal, and deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**5×10^{-4}**	**900**	NE (f)	Industrial	8×10^{-5}	0.3	NE				
Child	**3×10^{-4}**	**2,000**	NE	Construction	7×10^{-6}	0.3	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were detected at concentrations above CAOs in three surface soil samples. These contaminants likely originate from stormwater runoff from the Maintenance Area.

within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential use of the G Avenue Outfall at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to the previously identified contaminants in soil. However, industrial workers are still exposed to elevated levels of SVOCs.
- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the G Avenue Outfall.
- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.
- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-7 (Appendix A) presents the detailed cost estimate.

3.6.2.2 Alternative 2 – Excavation, Off-post Treatment/Disposal, and Deed Restrictions. Alternative 2 includes the excavation of approximately 135 yd^3 of contaminated soil to a depth of 1 foot bgs. Confirmatory soil samples are collected from the floor and each sidewall, and analyzed for benzo(a)anthracene, benzo(a)pyrene, and

benzo(b)fluoranthene. Excavation and confirmatory sampling continue until the quantitative CAOs for these contaminants are achieved.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 49 suggest that the COCs are not listed wastes. A review of the contaminant data also suggest that the soil will not exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) may be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal (as decided by the TSDF based on available resources and costs). The excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D nonhazardous waste landfill for disposal or to a local asphalt batching plant for incorporation into either hot- or cold-mix asphalt.

For purposes of the corrective action cost estimate, it is assumed that the excavated soil is not hazardous and can be disposed in a Subtitle D landfill. Clean soil from an on-post borrow site is backfilled into excavated areas, and the outfall is reconstructed. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 2 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 2 – excavation, off-post treatment/disposal and deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, off-post treatment/disposal, and deed restrictions meet the CAOs for the G Avenue Outfall developed in the CMS Work Plan (Dames & Moore, 2001). Off-post treatment/disposal

reduces the toxicity and mobility of contaminants. This alternative also complies with UAC R315-101-3, the "Principle of Non-Degradation," by removing contaminated soil from the site. Deed restrictions limit future exposure by preventing residential use of the G Avenue Outfall at SWMU 49. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

- Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal. Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place.

- Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle D landfill and a TSDF are located within 100 miles of TEAD. Because this alternative involves excavating soil to a depth of 1 foot bgs only, the presence of subsurface utilities does not significantly limit its implementation. Required equipment and materials are readily available. To meets CAOs, approximately 2 to 3 weeks are required for excavation, off-post transportation/disposal, and backfilling. Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

- Safety – Excavation and off-post treatment/disposal of surface soil pose minimal threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to contaminated soil. Restricting future development of the site also protects human health by preventing residential exposure to the previously identified contaminants in surface soil. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

- Environmental assessment – This alternative reduces risk to ecological receptors at the G Avenue Outfall.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $73,000. Table A-8 (Appendix A) presents the detailed cost estimate.

3.6.3 Comparative Analysis Of Corrective Measures Alternatives

Table 3-9 and the text below summarize the comparative analysis of the two corrective measures alternatives developed for the G Avenue Outfall (SWMU 49).

- Technical criteria

  – Performance – Both Alternative 1 (deed restrictions) and Alternative 2 (excavation, off-post treatment/disposal, and deed restrictions) are rated high with respect to performance. Both Alternatives meet the CAOs.

  – Reliability – Alternatives 1 and 2 are rated high for reliability. Each alternative has been proven effective at other sites and does not require onsite O&M activities – though O&M and long-term monitoring are required at the off-post landfills.

  – Implementability – Both alternatives are easy to implement, and are rated high. Equipment and contractors for excavation and removal are readily available.

  – Safety – Alternative 1 is rated high because no intrusive activities are required. Alternative 2 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for treatment/disposal. It presents short-term exposure to both onsite workers and offsite residential communities.

  – Human health assessment – Alternative 2 is rated high because it protects human health by preventing exposure to the identified contaminants through soil removal and deed restrictions. Alternative 1 is rated moderate because deed restrictions prevent residential use but industrial workers are exposed to SVOC contamination.

TABLE 3-9

Comparative Analysis of Corrective Measures Alternatives
G Avenue Outfall (SWMU 49) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost (b)
	Performance	Reliability	Implementability	Safety				
1. Deed restrictions	High	High	High	High	Moderate	Moderate	High	$12,000
2. Excavation, off-post treatment/disposal, and deed restrictions	High	High	High	Moderate	High	High	High	$73,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

- Environmental assessment – Alternative 2 is rated high because it reduces the ecological risk by removal of contaminated soil. Alternative 1 is rated moderate because although it does not affect the ecological risk, the risk was identified as moderate but not unacceptable.

- Administrative feasibility – Both Alternatives 1 and 2 are rated high. Both alternatives meet the requirements of UAC R315-101 but require deed restrictions.

- Cost – Of the two alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $12,000. The cost for Alternative 2 is estimated at $73,000.

3.6.4 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 2 – excavation, off-post treatment/disposal, and deed restrictions – is recommended as the preferred alternative for the G Avenue Outfall at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.7 H AVENUE OUTFALL

3.7.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks for hypothetical future adult and child residents at the H Avenue Outfall. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and to continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at the H Avenue Outfall.

The CAOs for the H Avenue Outfall are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the H Avenue Outfall at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 3-10 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the H Avenue Outfall in the CMS Work Plan (Dames & Moore, 2001).

3.7.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of the H Avenue Outfall at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

TABLE 3-10

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, H Avenue Outfall (SWMU 49)

Phase II RFI (SAIC, 1997)								**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Low	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**1×10^{-5}**	0.03	NE (f)	Industrial	1×10^{-6}	0.01	NE				
Child	**7×10^{-6}**	0.09	NE	Construction	1×10^{-7}	0.004	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

  - Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the H Avenue Outfall.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-9 (Appendix A) presents the detailed cost estimate.

3.7.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the H Avenue Outfall at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.8 J AVENUE OUTFALL

3.8.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks for hypothetical future adult and child residents at the J Avenue Outfall. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife. The Phase II RFI identified potential moderate risks based on HQs above 1 for intermittent surface drinking water source for jackrabbits. The SWERA concluded that there is no ecological habitat at this SWMU and rated the ecological risk as low. Based on the conclusions of both reports the potential ecological risks at this area of SWMU 49 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at the J Avenue Outfall.

The CAOs for the J Avenue Outfall are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the J Avenue Outfall at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 3-11 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the J Avenue Outfall in the CMS Work Plan (Dames & Moore, 2001).

3.8.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

TABLE 3-11

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, J Avenue Outfall (SWMU 49)

Phase II RFI (SAIC, 1997)								**CMS Work Plan (Dames & Moore, 2001)**			
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**3×10^{-6}**	0.02	NE (f)	Industrial	4×10^{-7}	0.002	NE				
Child	**2×10^{-6}**	0.05	NE	Construction	3×10^{-8}	0.0006	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

- Performance – Deed restrictions limit future exposure by preventing residential use of the J Avenue Outfall at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

- Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

- Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

- Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the J Avenue Outfall.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-10 (Appendix A) presents the detailed cost estimate.

3.8.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the J Avenue Outfall at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

3.9 K AVENUE OUTFALL

3.9.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the K Avenue Outfall. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 49 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The area surrounding the outfalls at SWMU 49 is slated to remain in industrial use and to continue to receive runoff from parking lots and roads in the Maintenance Area. The small area of habitat surrounding the outfalls only provide an intermittent exposure potential to wildlife. The Phase II RFI identified potential moderate risks based on HQs above 1 for intermittent surface drinking water source for jackrabbits. The SWERA concluded that there is no ecological habitat at this SWMU and rated the ecological risk as low. Based on the conclusions of both reports the potential ecological risks at this area of SWMU 49 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at the K Avenue Outfall.

The CAOs for the K Avenue Outfall are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the K Avenue Outfall at SWMU 49. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 3-12 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the K Avenue Outfall in the CMS Work Plan (Dames & Moore, 2001).

3.9.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 3.1.2.1. Deed restrictions on this area of SWMU 49 apply within the SWMU boundary presented on Figure 3-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential use of the K Avenue Outfall at SWMU 49 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because SWMU 49 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.
- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the K Avenue Outfall.
- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

TABLE 3-12

Summary of Phase II RFI and CMS Work Plan
Stormwater/Industrial Wastewater Piping, K Avenue Outfall (SWMU 49)

Phase II RFI (SAIC, 1997)										**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**2×10^{-6}**	**60**	NE (f)	Industrial	3×10^{-7}	0.2	NE				
Child	**1×10^{-6}**	**200**	NE	Construction	2×10^{-8}	0.02	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-11 (Appendix A) presents the detailed cost estimate.

3.9.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the K Avenue Outfall at SWMU 49 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

4.0 COMPRESSOR CONDENSATE DRAINS, BUILDINGS 613 AND 619 (SWMU 50)

Section 4.0 evaluates corrective measures alternatives for Buildings 613 and 619 at SWMU 50 (Figure 4-1). Data from the CMS Work Plan (Dames & Moore, 2001), and the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 50 is located in an area of the BRAC parcel designated for future industrial use. It consists of two compressor condensate drains located adjacent to Buildings 613 and 619 (Figure 4-1). Buildings 613 and 619 were evaluated independently because they are 800 to 1,000 feet apart and are separated by other maintenance buildings (SAIC, 1997).

Large air compressors associated with the vehicle maintenance mission of TEAD were located in Buildings 613 and 619. Standard procedure for the collection of condensate at these locations was to pipe the liquid into a partially buried 55-gallon drum with a perforated base. As the effluent flowed from the compressor, it moved through an open area – which may have been contaminated by lubricating oil from the compressor, inorganics from metal wear, or unknown materials from the indiscriminate disposal of waste at the drain (SAIC, 1997). The effluent was then piped to the gravel-filled drum and seeped into the underlying soil.

The Compressor Condensate Drain at Building 613 is located along the west exterior wall. The drain is located within an area of approximately 100 ft^2. An air duct connects the air handling unit, located west of the drain, to Building 613. Access to the drain is from the north only; the proximity of the buildings and the presence of the air duct limit the amount of exposed soil (SAIC, 1997).

The Compressor Condensate Drain at Building 619 is located along the north exterior wall of the central wing. The drain is located in an area of approximately 15 ft^2, is surrounded by exposed soil, and is flanked by buildings to the south and east. The remaining surface in this area is overlain by 8 to 12 inches of reinforced concrete (SAIC, 1997).

As a result of the BRAC process, all activities associated with operations at Buildings 613 and 619 have ceased. The drums and underlying soil at both buildings were excavated and removed during the RFI (SAIC, 1997). The buildings are closed and targeted for reuse in accordance with the TEAD Conversion and Reuse Plan (Tooele County Economic Development Corporation, 1995; SAIC, 1997).

4.1 BUILDING 613

4.1.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable HIs for hypothetical future adult and child residents at Building 613. Therefore, according to EPA guidance and UAC R315-101-6(d), the Compressor Condensate Drain at Building 613 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. No risks or HIs were calculated for current or future industrial workers because this area of SWMU 50 does not affect surface soil.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater (approximately 300 ft bgs).

Based on the Phase II RFI (SAIC, 1997), no ecological RA was required at SWMU 50 because it offers no attractive habitat. The Building 613 Compressor Condensate Drain is an approximately 100-ft^2 concrete pad.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at Building 613.

The CAOs for Building 613 are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for Building 613 at SWMU 50. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 4-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Building 613 Compressor Condensate Drain in the CMS Work Plan (Dames & Moore, 2001).

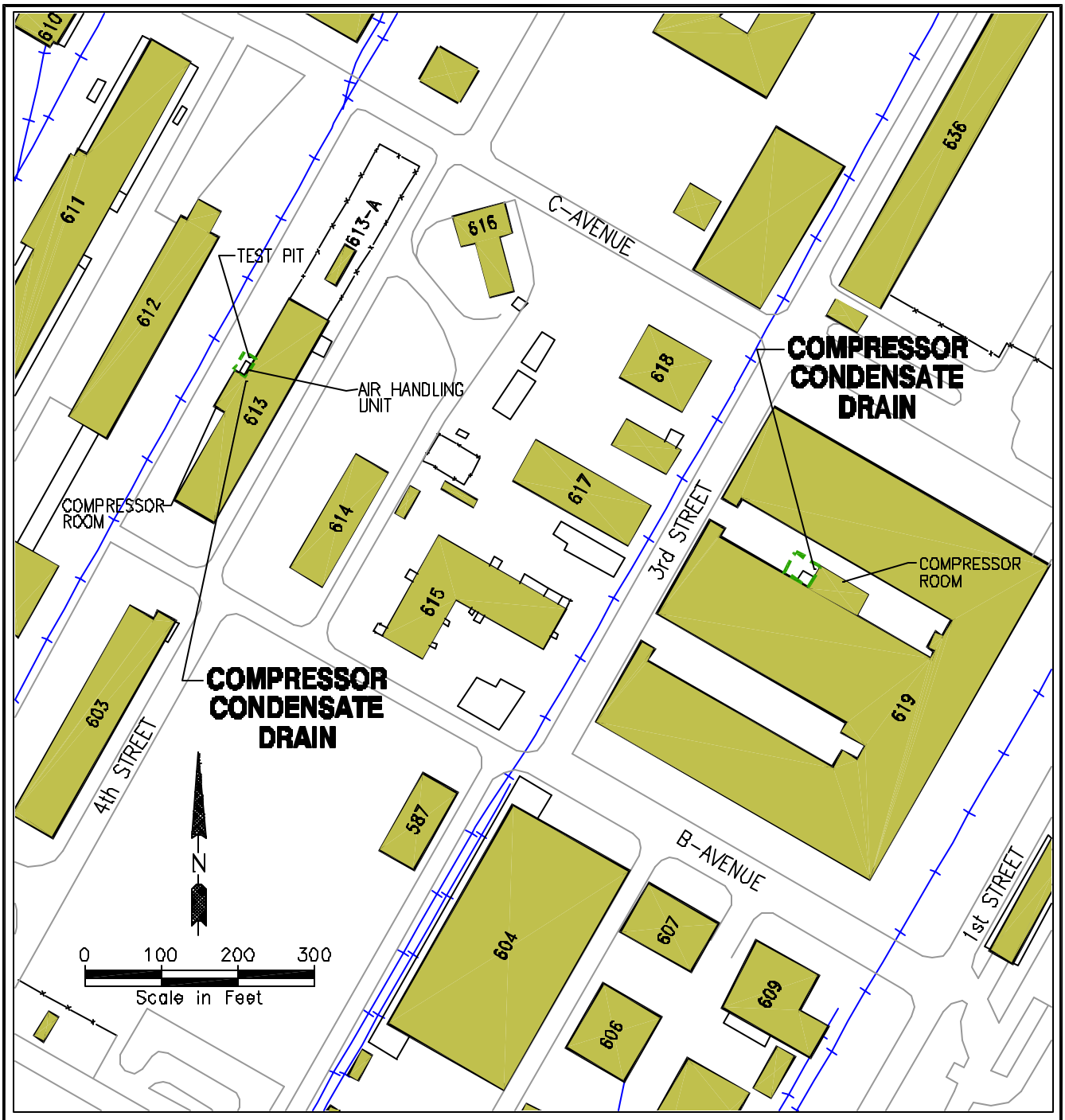

FIGURE 4-1
COMPRESSOR CONDENSATE DRAINS
BUILDINGS 613 AND 619 (SWMU 50)
TOOELE ARMY DEPOT

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TABLE 4-1

Summary of Phase II RFI and CMS Work Plan
Compressor Condensate Drains, Building 613 (SWMU 50)

Phase II RFI (SAIC, 1997)									CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Residential Land Use Scenario (c)				Realistic Future Land Use Scenario (d)				None	Low	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	3×10^{-7}	**3**	NE (f)	Industrial	NA (g)	NA	NE				
Child	2×10^{-7}	**8**	NE	Construction	2×10^{-9}	0.008	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Not applicable; risks and HIs are not calculated because surface soil samples were not collected.

4.1.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November, 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, the State of Utah Department of Environmental Quality, and the U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December, 1998).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

Deed restrictions on this area of SWMU 50 apply within the SWMU boundary presented on Figure 4-1 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of this area of SWMU 50 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

  – Implementability – Because Building 613 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

- Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding SWMU 50.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-12 (Appendix A) presents the detailed cost estimate.

4.1.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Building 613 Compressor Condensate Drain at SWMU 50 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

4.2 BUILDING 619

4.2.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at Building 619. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 50 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

Based on the Phase II RFI (SAIC, 1997), no ecological RA was required at SWMU 50 because it offers no attractive habitat. The Building 619 Compressor Condensate Drain is an approximately 100-ft^2 concrete pad.

The CMS Work Plan (Dames & Moore, 2001) identified arsenic as a COC in subsurface soil at Building 619. Arsenic exceeded its CAO at two locations; contaminated soil was removed from one of the locations during removal of the drum (SAIC, 1997). The remaining concentration of arsenic (57 µg/g) is greater than its CAO. The EPC calculated for arsenic is equal to the maximum concentration of 57 µg/g. Because the arsenic CAO corresponds to a cancer risk of 1×10^{-6}, the EPC calculation for arsenic does not result in unacceptable risk. Corrective action for removal of the soil around the identified arsenic COC location is considered along with management measures.

The CMS Work Plan estimated the extent of contamination at the Building 619, as shown on Figure 4-2. Based on the single arsenic COC location, the estimated extent of soil contamination is approximately 60 ft^2. The depth of contaminated soil is assumed to be 8 feet. The total volume of lead contaminated soil is approximately 18 yd^3. The actual areas and depths of contamination will be determined by confirmatory sampling during the corrective measure.

The CAOs for Building 619 are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment, regulatory requirements, and the small volume of contaminated soil, only two corrective measure alternatives are evaluated for Building 619 at SWMU 50. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternatives for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.
Alternative 2: Excavation and off-post treatment/disposal
Excavate contaminated soil. Fill and compact with clean soil. Characterize, transport, and treat/dispose of contaminated soil off post in accordance with U.S. Army protocols and State and Federal regulations

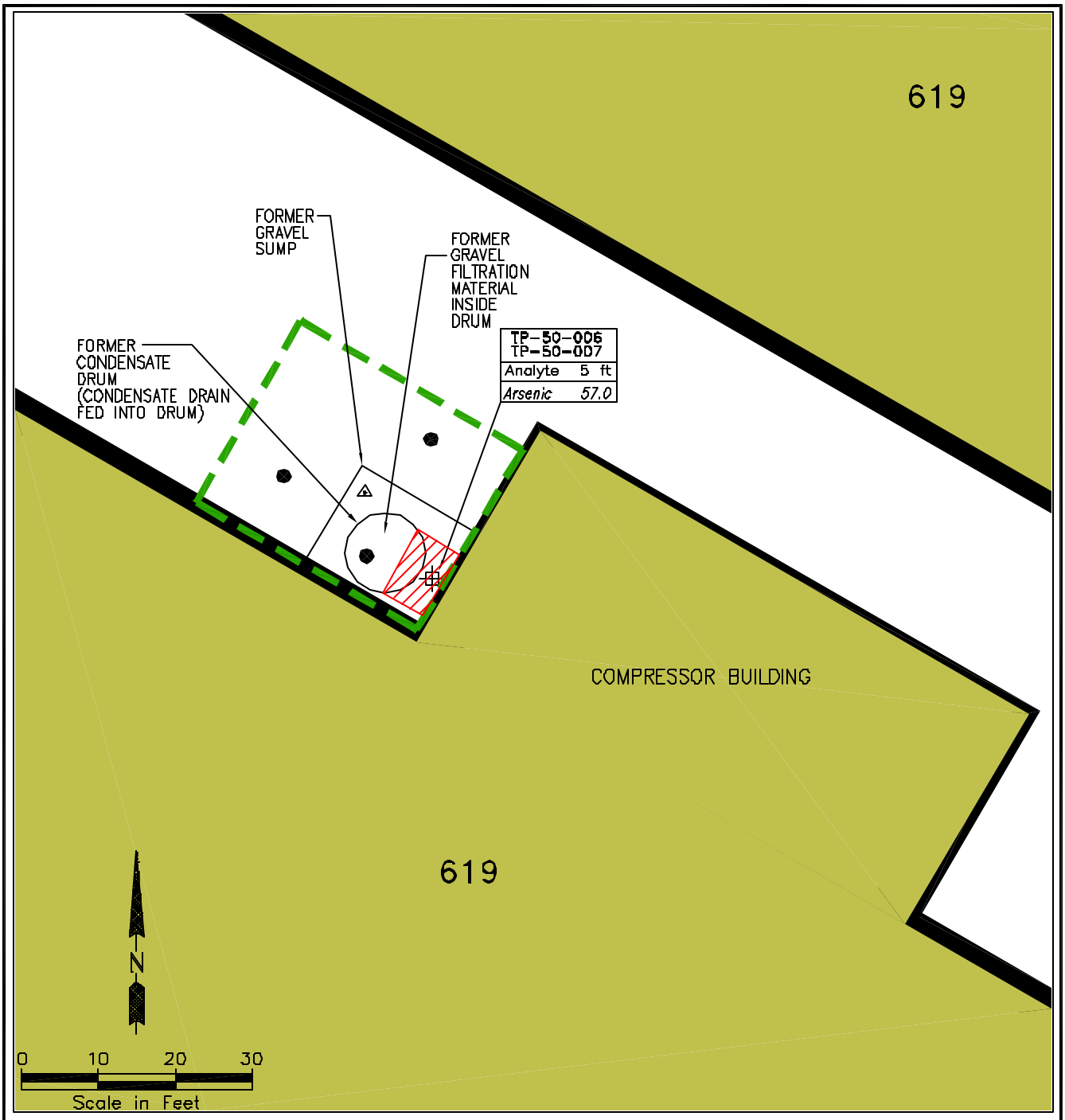

FIGURE 4-2
COC LOCATION AND APPROXIMATE AREA OF CONTAMINATION AT THE COMPRESSOR CONDENSATE DRAINS BUILDING 619 (SWMU 50)
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Table 4-2 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Building 619 Compressor Condensate Drain in the CMS Work Plan (Dames & Moore, 2001).

4.2.2 Detailed Evaluation of Corrective Measures Alternative

Section 4.2.2 evaluates the two corrective measures alternatives for Building 619.

4.2.2.1 Alternative 1 – Deed Restrictions. Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 4.1.2. Deed restrictions on this area of SWMU 50 apply within the SWMU boundary presented on Figure 4-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential use of this area of SWMU 50 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because Building 619 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to the previously identified contaminant in subsurface soil.

TABLE 4-2

Summary of Phase II RFI and CMS Work Plan
Compressor Condensate Drains, Building 619 (SWMU 50)

Phase II RFI (SAIC, 1997)								**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Low	Subsurface soil: Arsenic (h)	***Deed restrictions*** Excavation and off-post treatment/disposal
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**5×10^{-3}**	**30**	NE (f)	Industrial	NA (g)	6×10^{-5}	NE				
Child	**3×10^{-3}**	**80**	NE	Construction	6×10^{-6}	0.2	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Not applicable; risks are not calculated because none of the COPCs for the industrial worker has a toxicity value for carcinogenic effects.
(h) Arsenic was detected at concentrations above its CAO in only two samples.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding SWMU 50.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-13 (Appendix A) presents the detailed cost estimate.

4.2.2.2 Alternative 2 – Excavation and Off-post Treatment/Disposal. Alternative 2 includes excavation of approximately 18 yd^3 of metals contaminated soil to a depth of 8 feet bgs. Because the extent of contamination is estimated to be similar under industrial or residential evaluation criteria, cleanup to residential CAOs is recommended, and deed restrictions will not be necessary. Confirmatory samples are collected from the floor and each sidewall, and analyzed for arsenic. Excavation and confirmatory sampling continue until the quantitative CAO for arsenic is achieved.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 49 suggest that the arsenic in soil is not a listed waste. The contaminant data suggests that arsenic may (although not likely) exceed TCLP regulatory levels and the soil may therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal. The excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D landfill for disposal.

For purposes of this CMS, it is assumed that the excavated soil is hazardous and is treated and disposed at a TSDF. Clean soil from an on-post borrow site is backfilled into excavated areas. A gravel or asphalt cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 2 – excavation and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  - Performance – Excavation and off-post treatment/disposal of contaminated soil meet the CAOs for Building 619 developed in the CMS Work Plan (Dames & Moore, 2001). Off-post treatment and disposal reduce the toxicity and mobility of contaminants. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  - Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal.

  - Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle C landfill and a TSDF are located within 100 miles of TEAD. Required equipment and materials are readily available. However, shoring will be required and subsurface utilities may affect excavation activities. To meet CAOs, approximately one week is required for excavation, off-post transportation/disposal, and backfilling.

  - Safety – Excavation and off-post treatment/disposal of surface soil pose minimal to moderate short-term threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to the soil.

- Environmental assessment – This alternative has no effect on the environment surrounding Building 619.

- Administrative feasibility – This alternative complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101 by removing contaminated soil from the site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 2 is $26,000. Table A-14 (Appendix A) presents the detailed cost estimate.

4.2.3 Comparative Analysis Of Corrective Measures Alternatives

Table 4-3 and the text below summarize the comparative analysis of the two corrective measures alternatives developed for Building 619 (SWMU 50).

- Technical criteria

  – Performance – Both Alternative 1 (deed restrictions) and Alternative 2 (excavation, and off-post treatment/disposal) are rated high with respect to performance. Both alternatives meet the CAOs. Alternative 2 has an advantage over Alternative 1 in terms of long-term effectiveness. Alternative 2 removes the contaminated soil to residential levels and so no deed restrictions are required.

  – Reliability – Alternatives 1 and 2 are rated high for reliability. Each alternative has been proven effective at other sites and does not require onsite O&M activities – though O&M and long-term monitoring are required at the off-post landfills.

  – Implementability – Alternative 1 is easy to implement, and is rated high. Alternative 2 is rated moderate because although equipment and contractors for excavation and removal are readily available, shoring will be necessary and subsurface utilities may affect excavation activities.

  – Safety – Alternative 1 is rated high because no intrusive activities are required. Alternative 2 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for treatment/disposal. It presents short-term exposure to both onsite workers and offsite residential communities.

  – Human health assessment – Both Alternatives 1 and 2 are rated high because they protect human health by preventing residential exposure to the identified contaminants. Alternative 2 also removes soil with arsenic contamination. However, risks and HIs for industrial and construction workers are below target values and so Alternative 1 is also protective of human health. In addition, the COC is 5 feet bgs so exposure will only occur if the subsurface soil is excavated.

  – Environmental assessment – Both alternatives are rated high because they have no effects on the ecological environment which was identified as having low ecological risks.

  – Administrative feasibility – Both Alternatives 1 and 2 are rated high. Both alternatives meet the requirements of UAC R315-101. Alternative 1 also requires deed restrictions.

TABLE 4-3

Comparative Analysis of Corrective Measures Alternatives
Building 619 (SWMU 50) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost (b)
	Performance	Reliability	Implementability	Safety				
1. Deed restrictions	High	High	High	High	High	High	High	$12,000
2. Excavation, and off-post treatment/disposal	High	High	Moderate	Moderate	High	High	High	$26,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

– Cost – Of the two alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $12,000. The cost for Alternative 2 is estimated at $26,000.

4.2.4 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Building 619 Compressor Condensate Drain at SWMU 50 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

5.0 CHROMIC ACID/ALODINE DRYING BEDS (SWMU 51)

Section 5.0 evaluates corrective measures alternatives for the Chromic Acid/Alodine Beds of SWMU 51 (Figure 5-1). Data from the CMS Work Plan (Dames & Moore, 2001), and the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 51 is located in an area of the BRAC parcel designated for future industrial use. It consists of four concrete pads near the western edge of the Maintenance Area. The pads are located on an open lot adjacent to the southern end of the Consolidated Maintenance Facility, as shown in Figure 5-1. (Installation records identify SWMU 51 as Facility 623.) Each of the two eastern pads is 14 ft^2, with a slot cut from the center to the western edge. Each of the two western pads is 20 ft^2, with a berm around each edge to contain runoff and sediment. The western pads are located approximately 20 feet downslope of the eastern pads. Topography at SWMU 51 slopes toward the west-southwest, and runoff from precipitation tends to pond 50 feet southwest of the western pads. Groundwater beneath this area of TEAD is estimated to be 300 feet bgs and flows toward the northwest (SAIC, 1997).

During the 1970s, the pads were reportedly used as drying beds for chromic acid and alodine wastes. Additional information indicated that radiator and engine fluids may have been flushed/drained at the pads. Potential contaminants include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals (including cyanide). SWMU 51 is no longer used, and no evidence of recent usage was observed during investigations (SAIC, 1997).

5.1 SUMMARY OF RAs AND CMS WORK PLAN

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the Chromic Acid/Alodine Drying Beds. Therefore, according to EPA guidance and UAC R315-101-6(d), SWMU 51 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater (approximately 300 ft bgs).

Based on the Phase II RFI evaluations of COPC concentrations in soil (SAIC, 1997), the hazard quotients (HQ) for chromium, lead, and thallium – at 60, 11.5, and 16.6, respectively – are above the HQ threshold of 10 for vegetation receptors. No HQs exceeded 10 for jackrabbits or eagles. Thallium has an HQ of 27.9 in soil for deer mice,

which is below the background HQ of 49.7. All other HQs were less than 1.0 or could not be calculated for lack of toxicity data.

Although the Phase II RFI (SAIC, 1997) identified potential moderate ecological risks based on vegetation HQ levels, a high degree of uncertainty is associated with the SWMU 51 risk estimates due to limited toxicological information. Furthermore, most plant toxicity studies are conducted on vegetation that would not survive in the desert environment, such as typical agricultural crops (e.g., lettuce, wheat, and rice). Because of the physiochemical differences (i.e., high clay content, high native mineral content) in arid desert soil at TEAD compared to soil from wetter climates, as well as species differences, the estimated risks to plants at SWMU 51 (as indicated by higher HIs) are highly uncertain and the level of uncertainty does not support corrective action. The SWERA concluded that there is no ecological habitat at this SWMU and rated the ecological risk as low. Based on the conclusions of both reports, the potential ecological risk at SWMU 51 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

Using industrial use CAOs, benzo(b)fluoranthene was identified as a COC in surface soil at SWMU 51. The maximum concentration of 2 µg/g is barely measurable above the CAO of 1.9 µg/g. The EPC calculated in the RFI for benzo(b)fluoranthene (0.51 µg/g) is below the CAO.

The CAOs for SWMU 51 are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for the Chromic Acid/Alodine Drying Beds at SWMU 51. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this site:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 5-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for SWMU 51 in the CMS Work Plan (Dames & Moore, 2001).

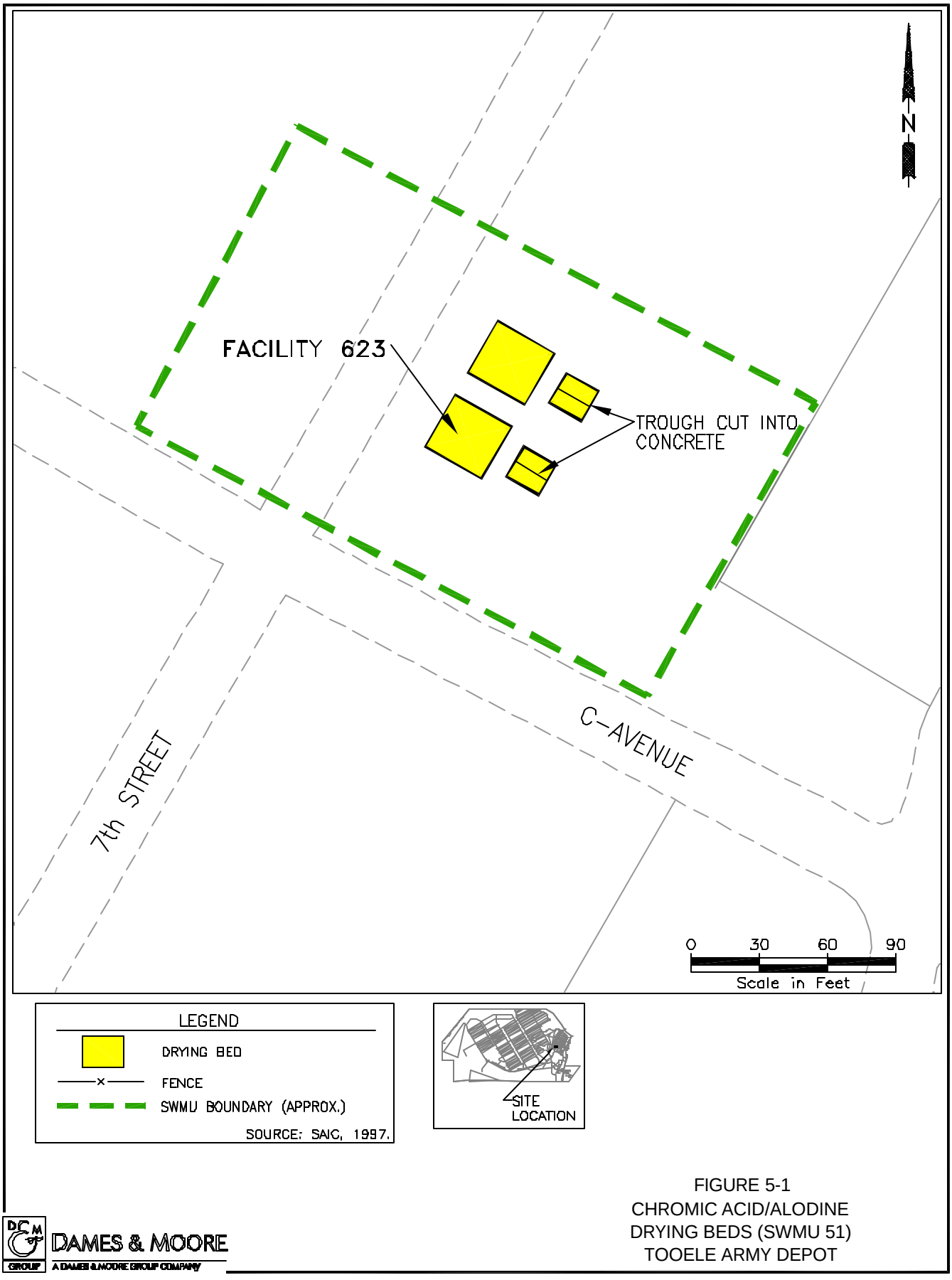


FIGURE 5-1
CHROMIC ACID/ALODINE
DRYING BEDS (SWMU 51)
TOOELE ARMY DEPOT

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

TABLE 5-1

Summary of Phase II RFI and CMS Work Plan
Chromic Acid/Alodine Drying Beds (SWMU 51)

Phase II RFI (SAIC, 1997)									**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	Surface soil: Benzo(b)fluoranthene (g)	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**6×10^{-6}**	**80**	NE (f)	Industrial	8×10^{-7}	0.4	6.0				
Child	**4×10^{-6}**	**200**	9.5	Construction	7×10^{-8}	0.08	8.3				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Benzo(b)fluoranthene was detected at concentrations slightly above its CAO and in only one sample.

5.2 DETAILED EVALUATION OF CORRECTIVE MEASURES ALTERNATIVE

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, the State of Utah Department of Environmental Quality, and the U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December 1998).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

Deed restrictions on SWMU 51 apply within the SWMU boundary presented on Figure 5-1 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of SWMU 51 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

  – Implementability – Because SWMU 51 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

- Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to the previously identified contaminant in surface soil.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the Chromic Acid/Alodine Drying Beds.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-15 (Appendix A) presents the detailed cost estimate.

5.3 RECOMMENDED CORRECTIVE MEASURES ALTERNATIVE

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Chromic Acid/Alodine Drying Beds at SWMU 51 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

6.0 POSSIBLE DRAIN FIELD/DISPOSAL TRENCHES (SWMU 52)

Section 6.0 evaluates corrective measures alternatives for the Disposal Trenches, Charcoal Material Area, and Horse Stable Area of SWMU 52 (Figure 6-1). Data from the CMS Work Plan (Dames & Moore, 2001), and the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 52 is located within the Administration Area of TEAD. It is part of the BRAC parcel and is designated for future residential use. It consists of four separate areas (SWMUs 52A, B, C, and D). The Phase I investigation identified an extensive drainage system of terracotta piping at SWMU 52A, Possible Drain Field. There were no signs of visible contamination, and the analytical results indicated no residual contamination. No risks or hazards were identified for this area and "no action" was recommended for SWMU 52A. SWMUs 52B, C, and D are discussed in Sections 6.1, 6.2, and 6.3, respectively.

6.1 DISPOSAL TRENCHES (SWMU 52B)

6.1.1 Summary of RAs and CMS Work Plan

The Disposal Trenches consist of a long mounded trench (150 by 40 feet) and several smaller mounds (Figure 6-1). Construction rubble and debris are found on the surface and buried throughout the area.

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for realistic future adult and child residents at the Disposal Trenches. Therefore, according to EPA guidance and UAC R315-101-6(e), corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. Risks and HIs for current and future industrial workers were not calculated because the materials buried in the trenches do not affect surface soil.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant concentrations in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The Phase II RFI (SAIC, 1997) indicated that there were no COPCs in the soil covering the Disposal Trenches to warrant an ecological RA of SWMU 52B. The Phase II RFI (SAIC, 1997) classified this area as posing a low ecological risk.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at SWMU 52B. Risks and HIs for future adult and child residents – the realistic future receptors – are based on exposure to subsurface soil and exceed target levels. The elevated HIs result from elevated thallium values found at 11.5 and 10 feet bgs, respectively. Clearly, residential

exposure to soil at such depths is unlikely. The elevated risks under the residential exposure scenario are due to the presence of beryllium detected at a concentration below the comprehensive basewide background level. Risks and HIs to all other receptors are below target values.

The CAOs for SWMU 52B are:

- To prevent exposure to subsurface soil by residential receptors.
- To ensure that – if the land use changes in the future to unlimited residential or other use – appropriate measures are taken to adequately protect human health and the environment.
- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for SWMU 52B. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

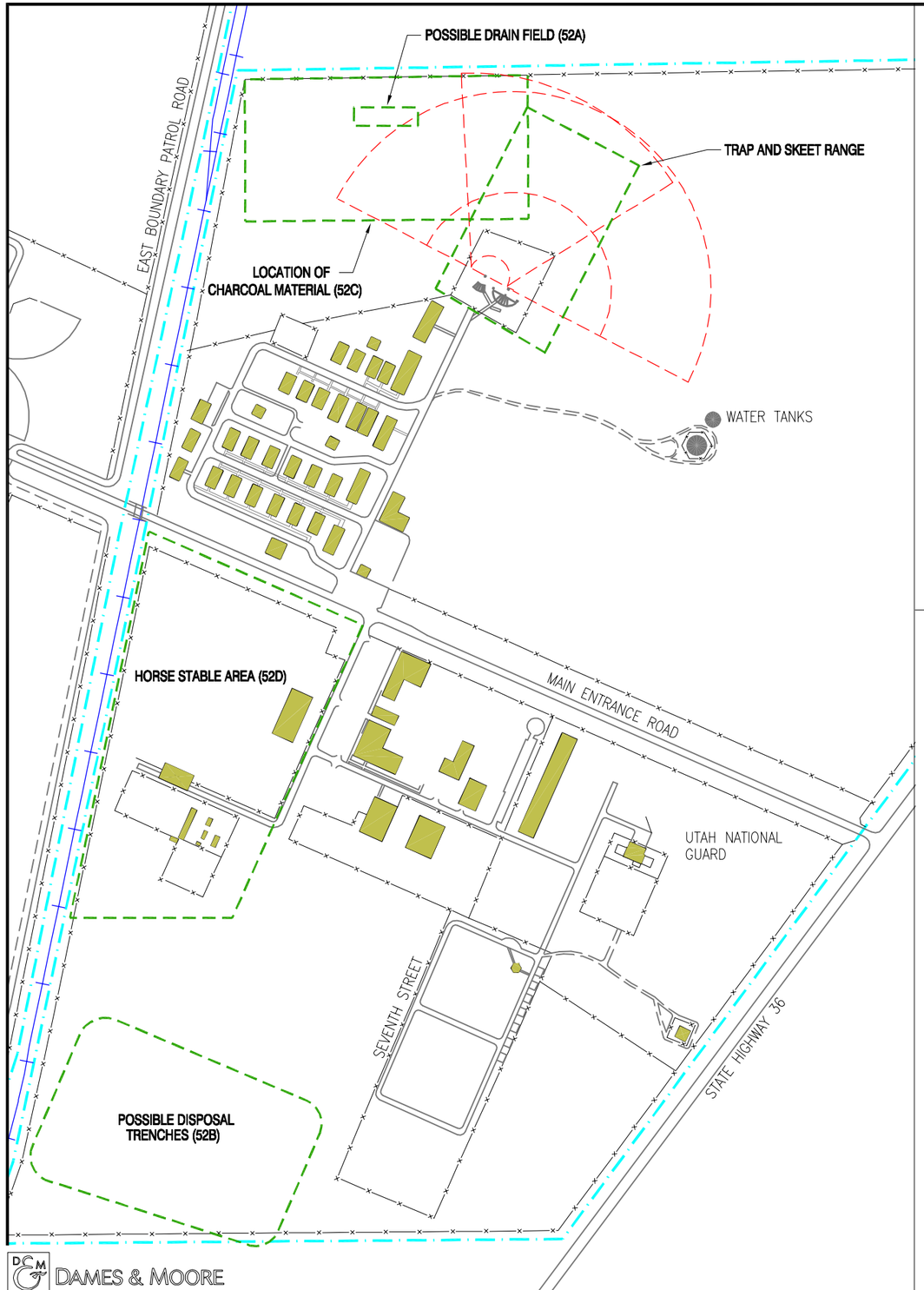
Alternative 1: Deed restrictions
Impose deed restrictions to limit residential development.

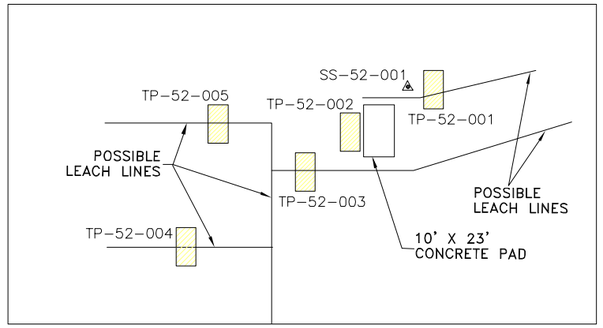
Table 6-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Disposal Trenches in the CMS Work Plan (Dames & Moore, 2001).

6.1.2 Detailed Evaluation of Corrective Measures Alternative

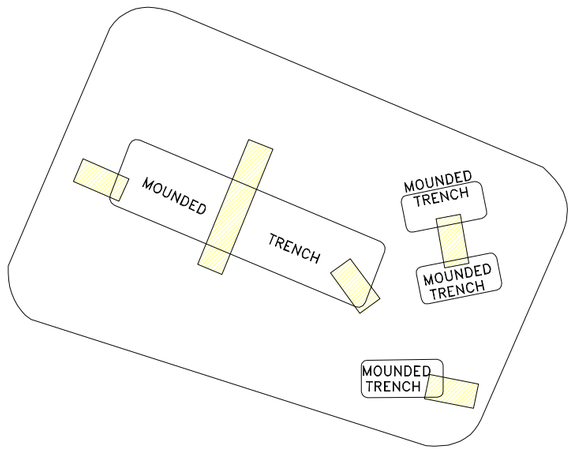
Alternative 1 is the application of deed restrictions to limit future residential use of the site. The restriction will not allow excavation of subsurface soil. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November, 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, the State of Utah Department of Environmental Quality, and the U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December, 1998).





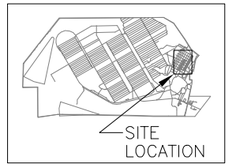
POSSIBLE DRAIN FIELD, SWMU 52A
NOT TO SCALE



POSSIBLE DISPOSAL TRENCHES, SWMU 52B
NOT TO SCALE

LEGEND

- BUILDING
- FENCE
- RAILROAD
- TEAD BOUNDARY
- SWMU BOUNDARY (APPROX.)
- EXCAVATION PIT (TEST PIT)
- PHASE I SURFACE SOIL SAMPLE



N

0 300 600 1200

SCALE: 1" = 600'

FIGURE 6-1
POSSIBLE DRAIN FIELD/
DISPOSAL TRENCHES (SWMU 52)
TOOELE ARMY DEPOT

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GROUP
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TABLE 6-1

Summary of Phase II RFI and CMS Work Plan
Disposal Trenches (SWMU 52B)

Phase II RFI (SAIC, 1997)						**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)				**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives**
Realistic Residential Land Use Scenario (b)				None	Low	None	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (c)**				
Adult	**2×10^{-5} (d)**	**300 (e)**	NE (f)				
Child	**1×10^{-5} (d)**	**800 (e)**	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(c) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(d) Elevated cancer risks due to beryllium in soil at a concentration below the comprehensive basewide background level.
(e) Elevated HIs due to elevated thallium values at 10 feet bgs and deeper.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

Deed restrictions on this area of SWMU 52B apply within the SWMU boundary presented on Figure 6-1 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria
  - Performance – Deed restrictions limit future exposure by preventing residential exposure to subsurface soil at SWMU 52B and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.
  - Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.
  - Implementability – Because SWMU 52B is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible, and immediately meets the CAOs.
  - Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.
- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to subsurface soil.
- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding SWMU 52B.
- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing residential exposure to subsurface soil.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-16 (Appendix A) presents the detailed cost estimate.

6.1.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for the Disposal Trenches at SWMU 52B because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

6.2 CHARCOAL MATERIAL AREA (SWMU 52C)

This 19.5-acre area is covered with various sized piles of charcoal-like material (Figure 6-2). Both the charcoal material and the native soil were sampled and analyzed.

6.2.1 Summary of RAs and CMS Work Plan

Human health RA calculations were performed separately for the charcoal material and surface soil, the soil beneath the charcoal material (surface and subsurface soil), and the areas free of charcoal material to determine whether risks and HIs are acceptable once the charcoal material is removed from the area.

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for realistic future adult and child residents exposed to charcoal material and surface soil. Unacceptable risks for realistic future adult, and unacceptable risks and HIs for realistic future child residents exposed to soil beneath the charcoal material were also identified. Therefore, according to EPA guidance and UAC R315-101-6(e), this area of SWMU 52 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers exposed to charcoal material and surface soil, and to soil beneath the charcoal material are below target values. Also, risks and HIs for all receptors exposed to soil in areas free of charcoal material are below target values.

The Phase II RFI (SAIC, 1997) indicated that there were no COPCs in soil at the Charcoal Material Area to warrant an ecological RA of SWMU 52C. The Phase II RFI (SAIC, 1997) classified this area as posing a low ecological risk.

The CMS Work Plan (Dames & Moore, 2001) identified benzo(a)anthracene as a COC in charcoal material. The EPC for benzo(a)anthracene is less than its CAO. No other COCs were identified at SWMU 52C. Under the realistic future land use scenario, the areas

containing charcoal material present unacceptable risks and hazards to human health. Therefore, corrective actions are evaluated for SWMU 52C.

The CMS Work Plan estimated the extent of contamination at SWMU 52C, as shown on Figure 6-2. COC locations are also shown. The area of contamination is estimated to include those areas on Figure 6-2 containing low, moderate, and high density of charcoal material. The volume estimate of contaminated material includes the charcoal material shown on Figure 6-2 and a small amount of near-surface soil directly beneath the piles. Based on soil sampling data presented in the RFI (SAIC, 1997), the soil beyond the perimeter of the piles is assumed to be clean. The estimated extent of the contaminated area is 51,000 ft^2. Assuming an average depth of 1 foot, the volume of contaminated soil at SWMU 52C is estimated to be 1,890 yd^3. The actual areas and depths of contamination will be determined by a visual survey and confirmation sampling when the selected corrective measures are implemented.

In addition to the previously discussed quantitative CAOs based on future residential use of the site, the CMS Work Plan (Dames & Moore, 2001) presented qualitative CAOs for SWMU 52C to comply with UAC R315-101, as follows:

- To protect other media from further degradation (i.e., to ensure that levels of contamination do not increase beyond existing levels, per UAC R315-101-3).
- To comply with UAC R315-101 and all its parts.
- To make the site suitable for future planned residential use.

Because of this relatively small volume of soil and the likely future use of the site for residential purposes, the CMS Work Plan (Dames & Moore, 2001) identified only one corrective measures alternative for the areas containing charcoal material, as described below:

Alternative 1: Excavation and off-post treatment/disposal
Excavate charcoal and contaminated soil
Fill and compact with clean soil
Characterize by TCLP analysis, transport, and treat/dispose of excavated material off post in accordance with U.S. Army protocol and Federal and State regulations.

Table 6-2 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the areas of charcoal material in the CMS Work Plan (Dames & Moore, 2001).

SS-52-001 (0 FT)
SVOCs
Benzo(a)anthracene 0.9

SS-52-003 (0 FT)
SVOCs
Benzo(a)anthracene 0.64 0.66(DUP)

SS-52-10 (0 FT)
SVOCs
Benzo(a)anthracene 1.0

SS-52-004 (0 FT)
SVOCs
Benzo(a)anthracene 0.7

SS-52-006 (0 FT)
SVOCs
Benzo(a)anthracene 0.9

TEL. POLE # 2
TEL. POLE # 3
TEL. POLE # 4
TEL. POLE # 5
GAS LINE
GAS VALVE
CONCRETE PAD
DRAIN FIELD DITCH 1'-3' DEEP
DITCH 1'-3' DEEP
WATER LINE
TP-52-001
TP-52-002
TP-52-003
TP-52-004
TP-52-005
B15
B7
C8
C10
C13
F1
H1

SWMU 57
TRAP AND SKEET RANGE

LEGEND
- FENCE
- RAILROAD
- TEAD BOUNDARY
- CONCRETE PAD
- TEST PIT LOCATION
- CHARCOAL MATERIAL LOCATION
- WATER LINE
- GAS LINE
- SWMU BOUNDARY
- SURVEY GRID
- TELEPHONE POLE
- LOW DENSITY OF CHARCOAL MATERIAL
- MODERATE DENSITY OF CHARCOAL MATERIAL
- HIGH DENSITY OF CHARCOAL MATERIAL
- PHASE I CHARCOAL MATERIAL SAMPLE LOCATION
- PHASE II CHARCOAL MATERIAL SAMPLE LOCATION
- PHASE II SURFACE SOIL
- PHASE II SOIL BORING
- SURFACE SOIL SAMPLING (NOT CHARCOAL)
- SOIL BORING (UNDER CHARCOAL)

CONCENTRATIONS IN ug/g

SITE LOCATION

N

0 125 250
SCALE: 1" = 125'

FIGURE 6-2
COC LOCATIONS AT THE
AREA CONTAINING CHARCOAL
MATERIAL (SWMU 52C)
TOOELE army DEPOT

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TABLE 6-2

Summary of Phase II RFI and CMS Work Plan
Charcoal Material Area (SWMU 52C)

Phase II RFI (SAIC, 1997)						**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)				**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Realistic Residential Land Use Scenario (c)				None	Low	Surface soil: Benzo(a)anthracene (f)	***Excavation and off-post treatment/disposal***
	Risk	**HI**	**Blood Lead Level (d)**				
Charcoal Material and Surface Soil							
Adult	**1×10^{-4}**	**20**	NE (e)				
Child	**8×10^{-5}**	**60**	NE				
Soil Beneath Charcoal Material							
Adult	**7×10^{-6}**	1	NE				
Child	**4×10^{-6}**	**3**	NE				
Soil in Areas Free of Charcoal Material							
Adult	8×10^{-8}	7×10^{-4}	NE				
Child	4×10^{-8}	0.002	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed. Because HIs are greater than 1 under the realistic future residential land use scenario, UAC R315-101-6(e) indicates that corrective actions must be evaluated.
(d) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(e) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(f) Benzo(a)anthracene was detected at concentrations above its CAO in samples containing charcoal material.

6.2.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 includes excavation of approximately 1,890 yd^3 of contaminated charcoal material/soil to a depth of 1 foot bgs. The area of material excavation is based on a visual observation survey performed before material removal begins. As per the RFI risk assessment, areas free of charcoal do not pose a risk. The Army may need to coordinate with the regulatory agencies to determine if areas with very low density of charcoal need removal and to define the cut-off density. Confirmatory samples are collected from the floor of the excavated areas to confirm that material with unacceptable levels of benzo(a)anthracene has been removed.

The excavated charcoal and soil undergoes a profile analysis to determine if the material exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 52 suggest that the COCs are not listed wastes. However, the contaminant data suggests that benzene could exceed TCLP regulatory levels and some of the material may therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If excavation material is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal. The excavated material is transported and manifested in compliance with applicable regulations.

- If the TCLP results are acceptable, the material is transported to an off-post Subtitle D landfill for disposal.

For the purposes of the corrective action cost estimate it is assumed that the excavated material is not hazardous and can be disposed in a Subtitle D landfill. However, as discussed previously some or all of the material could fail TCLP and be classified as RCRA hazardous. Because excavated material from different areas of the site may be disposed differently, material will be staged separately, as necessary, while waiting for soil profile analysis results. Clean soil from an on-post borrow site is backfilled into excavated areas. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 1 – excavation and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation and off-post treatment/disposal of contaminated charcoal material/soil meet the CAOs for SWMU 52C developed in the

CMS Work Plan (Dames & Moore, 2001). Off-post landfill disposal reduces the mobility of contaminants. This alternative also complies with UAC R315-101-3, the "Principle of Non-Degradation," by removing contaminated soil from the site. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

- Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal.

- Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and suitable landfills are located within 100 to 200 miles of TEAD. Because this alternative involves excavating soil to a depth of 1 foot bgs only, the presence of subsurface utilities does not significantly affect its implementation. Required equipment and materials are readily available. To meet CAOs, approximately 6 to 8 weeks is required for excavation, off-post transportation/disposal, and backfilling.

- Safety – Excavation and off-post disposal of surface soil pose minimal to moderate short-term threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to the soil.

- Environmental assessment – This alternative further reduces the already low ecological risk at SWMU 52C.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 and UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 1 is $550,000. Table A-17 (Appendix A) presents the detailed cost estimate.

6.2.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – excavation and off-post treatment/disposal – is recommended as the preferred alternative for the Charcoal Material Area of SWMU 52 because:

- It meets the requirements of UAC 315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

6.3 HORSE STABLE AREA (SWMU 52D)

The Horse Stable Area of SWMU 52, shown in Figure 6-3, was identified as an area of interest because several pesticides were detected in surface soil samples collected during an earlier investigation.

6.3.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks for realistic future residential adult and child residents at the Horse Stable Area. Because this area is designated for residential use, corrective measures are evaluated. Risks and HIs for current industrial workers and for future construction workers are below target values.

The Phase II RFI (SAIC, 1997) indicated that there were no COPCs in soil at the Horse Stable Area to warrant an ecological RA of SWMU 52D. The Phase II RFI (SAIC, 1997) classified this area as posing a low ecological risk.

The CMS Work Plan (Dames & Moore, 2001) identified chlordane as a COC in surface soil. It was detected at a concentration two orders of magnitude greater than its CAO. No COCs were identified in subsurface soil. The EPC for chlordane is slightly less than its CAO. Under the realistic future land use scenario, SWMU 52D presents unacceptable risks to human health. Because this site is adjacent to SWMU 35 (Operable Unit 4) where corrective actions for pesticides are recommended, corrective action for this site is to be performed with the SWMU 35 activities.

The CMS Work Plan estimated the extent of contamination at SWMU 52D, as shown on Figure 6-3. The COC locations used to define the area and volume of contaminated soil are also illustrated. The estimated extent of the contaminated area is 500 ft^2. Assuming a depth of 1.5 feet, the volume of contaminated soil at SWMU 52D is estimated to be 28 yd^3. The actual areas and depths of contamination will be determined by confirmatory sampling to be conducted when the selected corrective measures are implemented.

LEGEND

- SOIL BORING
- SURFACE SOIL SAMPLE (SAIC, 96)
- SURFACE SOIL SAMPLE (SAIC, 94)
- FENCE
- RAILROAD
- BUILDING
- TEAD BOUNDARY
- SWMU BOUNDARY (APPROX.)
- APPROXIMATE AREA OF CONTAMINATION

CONCENTRATIONS IN ug/g

SOURCE: RUST E&I, 1995

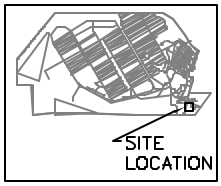

FIGURE 6-3
COC LOCATIONS AND APPROXIMATE AREA
OF CONTAMINATION AT THE
HORSE STABLE AREA (SWMU 52D)
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In addition to the previously discussed quantitative CAOs based on future residential use of the site, the CMS Work Plan (Dames & Moore, 2001) presented qualitative CAOs for SWMU 52D, as follows:

- To protect other media from further degradation (i.e., to ensure that levels of contamination do not increase beyond existing levels, per UAC R315-101-3).

- To protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Because of the small volume of contaminated soil and the likely future use of the site for residential purposes, the CMS Work Plan (Dames & Moore, 2001) identified only one corrective measures alternative for the Horse Stable Area, as described below:

Alternative 1: Excavation and off-post treatment/disposal
Excavate contaminated soil
Fill and compact with clean soil
Characterize by TCLP analysis, transport, and treat/dispose of excavated soil off-post in accordance with U.S. Army protocol and Federal and State regulations.

Table 6-3 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the Horse Stable Area in the CMS Work Plan (Dames & Moore, 2001).

6.3.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 includes excavation of approximately 28 yd^3 pesticides-contaminated soil to a depth of 1.5 feet bgs. Confirmatory soil samples are collected from the floor and each sidewall, and analyzed for chlordane. Excavation and confirmatory sampling continue until the quantitative CAO for chlordane is achieved. The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 52 suggest that the pesticides in soil are a result of normal application and are not listed wastes. However, the contaminant data suggests that chlordane may exceed TCLP regulatory levels and the soil will therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR

TABLE 6-3

Summary of Phase II RFI and CMS Work Plan
Horse Stable Area (SWMU 52D)

Phase II RFI (SAIC, 1997)						**CMS Work Plan (Dames & Moore, 2001)**	
Human Health Risk Assessment (a)				**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Realistic Residential Land Use Scenario (c)				None	Low	Surface soil: Chlordane (f)	***Excavation and off-post treatment/disposal***
	Risk	**HI**	**Blood Lead Level (d)**				
Adult	**3×10^{-6}**	0.03	NE (e)				
Child	**2×10^{-6}**	0.07	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, corrective measures have been evaluated.
(d) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(e) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(f) Chlordane was detected at concentrations above CAOs in only one sample.

guidelines), or to a TSDF for treatment prior to disposal. The excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D nonhazardous waste landfill for disposal.

For purposes of this CMS, it is assumed that the excavated soil is shipped to a TSDF for pretreatment by incineration prior to disposal in a Subtitle C landfill. Clean soil from an on-post borrow site is backfilled into excavated areas. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

The soil contamination at this site is recommended to be included as part of the SWMU 35 (Operable Unit 4) corrective action which also consist of excavation of pesticides-contaminated soil in the immediate area of SWMU 52D.

Alternative 1 – excavation and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation and off-post treatment/disposal of contaminated soil meet the CAOs for SWMU 52D developed in the CMS Work Plan (Dames & Moore, 1998). Off-post incineration and disposal in a Subtitle C landfill reduce the toxicity and mobility of contaminants. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal.

  – Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle C landfill and a TSDF are located within 100 miles of TEAD. Because this alternative involves excavating soil to a depth of 1 foot bgs only, the presence of subsurface utilities does not significantly affect its implementation. Required equipment and materials are readily available. To meet CAOs, approximately 1 to 2 weeks are required for excavation, off-post transportation/disposal, and backfilling.

  – Safety – Excavation and off-post treatment/disposal of surface soil pose minimal to moderate short-term threats to workers, off-post residential

communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to the soil.

- Environmental assessment – This alternative further reduces the low ecological risk at SWMU 52D.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 and UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 1 is $41,000. Table A-18 (Appendix A) presents the detailed cost estimate. However, the soil contamination at this site should be included as part of the SWMU 35 corrective action.

6.3.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – excavation and off-post treatment/disposal – is recommended as the preferred alternative for the Horse Stable Area of SWMU 52 because:

- It meets the requirements of UAC 315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

7.0 SANDBLAST AREAS (SWMU 54)

Section 7.0 evaluates corrective measures alternatives for the Sandblast Areas (SWMU 54; Figure 7-1). Data from the CMS Work Plan (Dames & Moore, 2001), and the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 54 is located within the BRAC parcel and is to be used for industrial/commercial purposes. The Sandblast Areas include three buildings where sandblasting occurred:

- Building 604 – power train and Special Equipment Branch location.
- Building 611 – location of military standard engine and small generator overhaul activities.
- Building 637 – location of engine rebuild activities.

No sandblasting has been conducted at SWMU 54 since 1994 (SAIC, 1997). (The primary areas of sandblasting activities at the TEAD Maintenance Area are Buildings 615/617 and Building 600. These buildings are addressed in the Group B CMS Work Plan (Dames & Moore, 2001).)

Three types of sandblast media (i.e., steel grit, ground walnut shells, and glass beads) were used inside Buildings 604, 611, and 637. The spent media had the consistency of fine dust and were collected in sealed hoppers located outdoors.

Activities conducted in Building 604 included assembly and disassembly of power trains, brake overhauls, and brake shoe manufacturing. Solvents and a vapor degreaser were used for cleaning and loosening parts. Several cabinet blast boxes were also used with glass-bead and walnut-grit abrasives (SAIC, 1997). The collection hopper was located on a concrete pad along the southeastern side of the building.

Engines and generators were disassembled, overhauled, and reassembled in Building 611. Small parts needing rust removal were cleaned in a small grit sandblaster using glass-bead or steel-grit abrasives. The hopper was located on a concrete pad on the northwestern side of the building. A loading dock is located north of the concrete pad. Building 611 was also the site of a small arms firing range. Spent lead bullets were removed from the building to an area south of the concrete pad (SAIC, 1997).

In Building 637, engines were steam cleaned and disassembled, and paint and rust were removed using dip tanks and steel-grit blasting machines. The collection hopper was located on the northwest side of the building; the area beneath the hopper was covered by loose gravel and ballast from an adjacent railroad spur (SAIC, 1997).

The SWMU 54 buildings were closed in 1994, and all maintenance activities have ceased. The sandblasting equipment, including the hoppers, were removed from Buildings 611 and 637; however, a small dust collector remains at Building 604. Because elevated concentrations of barium, cadmium, chromium, lead, nickel, and semivolatile organic compounds (SVOCs) were detected in analytical samples of spent media, soil samples were collected from around the hoppers to evaluate whether contaminants had been released to the surrounding soil (SAIC, 1997).

7.1 BUILDING 604

7.1.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at Building 604. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 54 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers are below target values. No risks or HIs were calculated for current or future industrial workers because site activities did not affect surface soil.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant distributions in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

Based on the Phase II RFI (SAIC, 1997), no ecological RA was necessary for SWMU 54 because there is no ecological habitat sufficient to support small mammals or larger vertebrates at this site.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at Building 604. A review of the human health RA conducted in the RFI (SAIC, 1997) indicates that the cancer and noncancer risks derive from beryllium and thallium, respectively, even though their concentrations are below their CAOs. Beryllium is located in one subsurface sample (5 ft bgs) at a concentration of 1.34 µg/g, which is below the comprehensive basewide background value of 1.5 µg/g. Thallium is also only located in one sample location, at a concentration of 14.5 µg/g, which is below the comprehensive basewide background level of 54 µg/g. Therefore, no corrective measures are recommended for Building 604 of SWMU 54.

Table 7-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997). No action is acceptable at Building 604 at SWMU 54 because the risks and hazards at this SWMU derive from metals below background. This alternative does not mitigate potential residential risk at the site because it provides no additional protection of human health beyond current conditions. No unacceptable ecological risks or impacts to the environment were identified at this site.

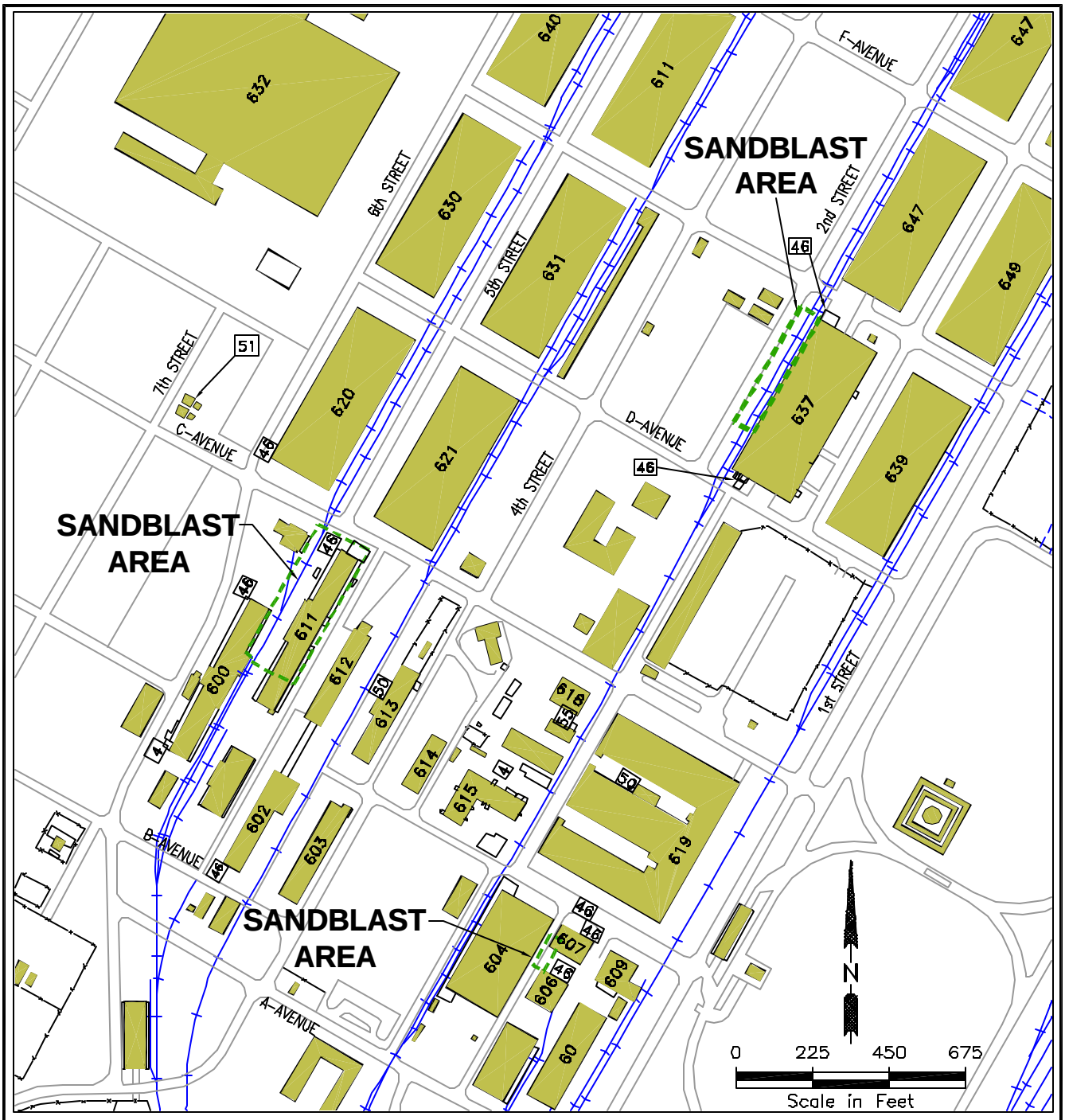

FIGURE 7-1
SANDBLAST AREAS (SWMU 54)
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TABLE 7-1

Summary of Phase II RFI and CMS Work Plan
Sandblast Areas, Building 604 (SWMU 54)

Phase II RFI (SAIC, 1997)									CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Residential Land Use Scenario (c)				Realistic Future Land Use Scenario (d)				None	Low	None	***No action***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Adult	**3×10^{-5} (f)**	**90 (g)**	NE (h)	Industrial	NA (i)	0.2	NE				
Child	**2×10^{-5} (f)**	**200 (g)**	NE	Construction	7×10^{-7}	0.03	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because risks, HIs, or blood lead levels are less than 1×10^{-4}, 1, or 10 µg/dL, respectively, UAC R315-101-6(d) indicates that management measures can be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) Elevated cancer risks due to beryllium in soil at a concentration below the comprehensive basewide background level.
(g) Elevated HIs due to thallium in soil at a concentration below the comprehensive basewide background level.
(h) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(i) Not applicable; cancer risks are not quantified because none of the COPCs for the industrial worker has a toxicity value for carcinogenic effects.

7.2 BUILDING 611

7.2.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at Building 611. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 54 is included in the CMS process, and corrective measures must be evaluated. There were no identified unacceptable risks and HIs for current and future industrial workers and for future construction workers. However, the estimated blood lead levels for child residents, the current and reasonably anticipated future industrial workers, and the reasonably anticipated future construction workers are above the CDC guidance level of 10 µg/dL.

No ecological RA was performed for Building 611 because the site has no ecological habitat or insufficient areas to support small mammals or larger vertebrates (SAIC, 1997). Therefore, no corrective measures are recommended to mitigate ecological risks at this area of SWMU 54.

In 1998, the U.S. Army Corps of Engineers (USACE)-Sacramento District demolished the portion of Building 611 that contained the test firing range (USACE, 1999). The range was built in the 1960s as an addition to two separate buildings, which were then joined to form Building 611.) An area of approximately 5 feet by 140 feet along the west edge of the firing range was excavated during the demolition to a depth of 1 foot and backfilled with clean material. As part of this action, the road on the west side of the building (which was damaged during the removal action) was repaved with 3 inches of cover soil topped by 3 inches of asphalt. Figure 7-2 shows the approximate area excavated.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on the concentrations of COPCs in soil (SAIC, 1997).

The CMS Work Plan (Dames & Moore, 2001) identified COCs by comparing the maximum concentration of each COPC identified in the Phase II RFI Report (SAIC, 1997) to the respective quantitative CAO. Using industrial use CAOs, cadmium and lead were identified as COCs in surface soil at Building 611. The EPC for cadmium is below its CAO while the EPC for lead is more than twice its CAO. No COCs were identified in subsurface soil at this site. Given the widespread lead contamination at Building 611, the exceedance of the CDC guideline for blood lead levels for the industrial and construction worker land use scenarios, and lead's EPC, corrective actions are recommended to address contamination in this area of SWMU 54.

The CMS Work Plan estimated the extent of contamination at Building 611, as shown on Figure 7-2. The COC locations used to define the areas and volumes of contaminated soil are also shown. Based on the soil sampling data presented in detail in the Phase II RFI (SAIC, 1997), the contaminated soil is assumed to extend to an average depth of 2 feet bgs. The total area containing soil contaminated with metals is estimated

FORMER USED
OIL DUMSTER
BUILDING 611, SWMU46

C-AVENUE

SAND BLAST
AREA

SB-54-21	
Analyte	0 ft
Lead	*110,000.0*

SB-54-21	
Anayte	0.5 ft
Lead	*1,900.0*

SS-46-050	
Analyte	0 ft
Lead	*3,000*

SS-54-50	
Analyte	0 ft
Lead	*8,700.0*

SS-54-49	
Analyte	0 ft
Lead	*3,200.0*

SS-54-48	
Analyte	0 ft
Lead	*3,200.0*

SS-54-46	
Analyte	0 ft
Cadmium	*274.0*
Lead	*7,700.0*

SS-54-018	
Analyte	0 ft
Cadmium	*266.0*
Lead	*4000.0*

LEGEND

- BUILDING
- FENCE
- RAILROAD
- SWMU BOUNDARY (APPROX.)
- PHASE I SOIL BORING
- PHASE II SOIL BORING
- PHASE I SURFACE SOIL SAMPLE
- PHASE II SURFACE SOIL SAMPLE
- APPROXIMATE AREA OF USACE REMOVAL ACTION*
- APPROXIMATE AREA OF CONTAMINATION

CONCENTRATIONS IN ug/g

* NOTE: This removal action was completed in 1998 to depth of 1 foot bgs.

SITE LOCATION

N

0 30 60 120

SCALE: 1" = 60'

FIGURE 7-2
COC LOCATIONS AND APPROXIMATE AREA OF CONTAMINATION AT THE SAND BLAST AREAS (SWMU 54)
BUILDING 611
TOOELE ARMY DEPOT

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to be 2,100 ft^2. The total volume of soil contaminated with metals is approximately 156 yd^3. Corrective measures for Building 611 are assumed to be coordinated with those for the lead-contaminated soil at the former used oil dumpster location at the northwest corner of the building (SWMU 46, Group B), which adds an additional volume of 4 yd^3. The actual areas and depths of contamination will be determined by confirmatory sampling to be conducted when the selected corrective measures are implemented.

In addition to the previously discussed quantitative CAOs based on future industrial use of the site, the CMS Work Plan (Dames & Moore, 2001) presented qualitative CAOs for Building 611, as follows:

- To protect other media from further degradation (i.e., to ensure that levels of contamination do not increase beyond existing levels, per UAC R315-101-3).

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

The CMS Work Plan (Dames & Moore, 2001) identified three alternatives to address metals in surface soil at Building 611, as noted below:

Alternative 1: Excavation, off-post treatment/disposal, and deed restrictions
Excavate contaminated soil Fill and compact with clean soil Characterize by TCLP analysis, transport, and treat/dispose of metals-contaminated soil off post in accordance with U.S. Army protocols and State and Federal regulations (metals-contaminated soil may require pretreatment off post by solidification/stabilization) Impose deed use restrictions to prevent residential development
Alternative 2: Excavation, soil washing, and deed restrictions
Excavate contaminated soil Treat excavated soil on post by soil washing and segregate fine soil portion Backfill excavation with treated soil, cover with clean soil, and revegetate Characterize, transport, and dispose of metals-contaminated fine soil fraction off post in accordance with U.S. Army protocols and State and Federal regulations (metals-contaminated soil may require pretreatment off post by solidification/stabilization) Impose deed use restrictions to prevent residential development

Alternative 3: Excavation, solidification/stabilization, and deed restrictions
Excavate contaminated soil Solidify/stabilize excavated soil on post by mixing with chemical reagents Backfill excavation with treated soil, cover with clean soil, and revegetate Impose deed use restrictions to prevent residential development

Table 7-2 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for Building 611, SWMU 54 in the CMS Work Plan (Dames & Moore, 2001).

7.2.2 Detailed Evaluation of Corrective Measures Alternatives

Section 7.2.2 evaluates the three corrective measures alternatives for the Building 611 of SWMU 54. Each alternative includes excavation of the metals-contaminated soil, in combination with off-post treatment/disposal or treatment technologies.

7.2.2.1 Alternative 1 – Excavation, Off-Post Treatment/Disposal, and Deed Restrictions. As part of Alternative 1, the metals contaminated soil is excavated using a backhoe, front-end loader, or similar equipment. Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for cadmium and lead. Soil is excavated until the quantitative CAOs for cadmium and lead are met. An x-ray fluorescence (XRF) field instrument may be used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 2 feet, resulting in a total volume of 156 yd^3. Under this alternative, the lead contaminated soil at the former used oil dumpster location at the northwest corner of Building 611 (SWMU 46, Group B) shall also be excavated, which adds on additional volume of 4 yd^3.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination in this area of SWMU 54 suggest that the metals in soil are not listed wastes. However, the contaminant data suggests that cadmium and lead will exceed TCLP regulatory levels and the soil will therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal. The

TABLE 7-2

Summary of Phase II RFI and CMS Work Plan
Sandblast Areas, Building 611 (SWMU 54)

Phase II RFI (SAIC, 1997)									CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Hypothetical residential land use scenario (c)				Actual (and likely future) land use scenario (d)				None	Low	Surface soil: Cadmium Lead	***Excavation, off-post treatment/ disposal, and deed restrictions*** Excavation, soil washing, and deed restrictions Excavation, solidification/ stabilization, and deed restrictions
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (d)**				
Adult	**2×10^{-6}**	**90**	NE (f)	Industrial	1×10^{-7}	1	**17**				
Child	**1×10^{-6}**	**200**	**34**	Construction	1×10^{-8}	0.4	**32**				

(a) Risks, HIs, and blood lead levels that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, and 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the realistic land use scenario. Because blood lead levels are greater than 10 µg/dL, UAC R315-101-6(e) indicates corrective actions must be evaluated.
(e) Blood lead levels are expressed as the 95^{th} percentile concentration (µg/dL). The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D landfill for disposal or to a local asphalt batching plant for incorporation into either hot- or cold-mix asphalt.

For purposes of this CMS and based on the relatively high concentrations of lead in the metals-contaminated soil, it is assumed that this soil is classified as a hazardous waste in accordance with RCRA and State of Utah regulations. Therefore, the metals-contaminated soil is transported to a TSDF, where it is pretreated by solidification/ stabilization prior to placement in the landfill. Clean soil from an on-post borrow site is backfilled into each of the excavated areas. A gravel cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 1 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, the State of Utah Department of Environmental Quality, and the U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December 1998).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

Deed restrictions on this area of SWMU 54 apply within the SWMU boundary presented on Figures 7-1 and 7-2 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – excavation, off-post treatment/disposal and land use restrictions – is evaluated as follows:

- <u>Technical criteria</u>

  – <u>Performance</u> – Excavation, off-post treatment/disposal and deed restrictions of contaminated soil complies with UAC R315-101-3, the

"Principle of Non-Degradation," by preventing future migration of metals from soil to other environmental media at the site. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to site contaminants. This alternative is applicable to both site and contaminant characteristics. Because contaminants are physically removed from the site, the quantitative CAOs are met with no decrease in effectiveness over time. Deed restrictions limit future exposure by preventing residential use of the site.

- Reliability – Excavation, off-post treatment/disposal and deed restrictions are effective over the long term and have been effectively implemented at other sites. Deed restrictions should prevent future residential exposure to contaminated soil at the site. Management of waste materials is limited to contaminated soil and no long-term environmental monitoring is required. Some degree of long-term liability may be associated with the disposal of contaminated soil in an off-post landfill or with its use in asphalt products.

- Implementability – Excavation equipment for this alternative is readily available. A Subtitle C landfill is located within 100 miles of TEAD. In addition, Subtitle D landfills are located within 100 to 200 miles of TEAD, and an asphalt batching plant is located within approximately 15 miles of TEAD. Because Alternative 1 requires excavation, subsurface utilities may possibly affect implementation, though the presence of such obstructions is unlikely. To meet the CAOs, approximately 2 to 3 weeks are required for excavation, off-post transportation/disposal, and backfilling. Because this site is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

- Safety – Alternative 1 poses minimal to moderate short-term risks to off-post residential communities and onsite workers. Residential communities may be exposed to contaminated soil during transportation and off-post treatment/disposal of the soil. Onsite workers may be exposed to contaminated soil during excavation and soil-handling. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

- Human health assessment – Excavation, off-post treatment/disposal, and deed restrictions protect human health by preventing both short- and long-term soil exposure. Restricting future development of the site protects human health by preventing residential exposure. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

- Environmental assessment – This alternative further reduces the already low ecological risk at Building 611 of SWMU 54.

- Administrative feasibility – Alternative 1 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by removing the contaminated soil from the site and preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 1 is $120,000. Table A-19 (Appendix A) presents the detailed cost estimate.

7.2.2.2 Alternative 2 – Excavation, Soil Washing, and Deed Restrictions. For Alternative 2, the metals contaminated soil is excavated using a backhoe, scraper, or other similar equipment. Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for cadmium and lead. Soil is excavated until the quantitative CAOs for cadmium and lead are met. An XRF field instrument may be used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 2 feet, resulting in a total volume of 156 yd^3. Under this alternative, the lead contaminated soil at the former used oil dumpster location at the northwest corner of Building 611 (SWMU 46, Group B) shall also be excavated, which adds an additional volume of 4 yd^3.

Prior to onsite soil washing, the excavated soil is blended and stockpiled. Screens are used to remove large rocks and other debris from the excavated soil. Water or proprietary solution is then added to a trommel or other size classification device, and the soil is separated into coarse and fine fractions. The fine particles – which are assumed to contain the majority of lead and cadmium contamination – are subjected to an acid leach, which is regenerated onsite using an ion exchange resin (Battelle, 1997). When the resin is fully loaded, it is shipped off-post for treatment/disposal at a Subtitle C landfill or TSDF, as appropriate. Because the concentrations of lead is expected to be high, it is assumed that the fine-grained particles are classified as hazardous waste in accordance with applicable RCRA TCLP criteria, and that they are shipped off-post for disposal at a Subtitle C hazardous waste landfill. The fine-grained particles are expected to require pretreatment (i.e., solidification/stabilization) at the selected TSDF facility to comply with RCRA prior to disposal in the landfill.

Large rocks, debris, and coarse-grained particles that meet applicable TCLP levels for lead and cadmium are returned to the areas from which they were excavated. In addition, clean soil from an on-post borrow area is backfilled into the excavated areas, as necessary. A gravel cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns. If the soil washwater or proprietary solution contains excessive amounts of lead or other

contaminants, it is treated onsite using ion exchange resins or another appropriate treatment method.

Pretreatment testing is required prior to final design of Alternative 2 to evaluate the effectiveness of soil washing at this site and to develop optimal process design criteria.

Alternative 2 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 7.2.2.1. Deed restrictions on this area of SWMU 54 apply within the SWMU boundary presented on Figures 7-1 and 7-2 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 2 – excavation, soil washing, and deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, soil washing, and deed restrictions are likely to meet both the quantitative and qualitative CAOs developed for this site. This alternative complies with UAC R315-101-3, the "Principle of Non-Degradation," by treating metals-contaminated soil, thereby preventing the future migration of metals from soil to other environmental media. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to these contaminants at the site. Alternative 2 is applicable to both site and contaminant characteristics. Because contaminants are physically removed from the site, the quantitative CAOs are expected to be met with no decrease in effectiveness over time. Deed restrictions limit future exposure by preventing residential use of the site.

    Pretreatment testing must be conducted to confirm the effectiveness of soil washing for achieving the quantitative CAOs for lead and cadmium. This process may not be an appropriate treatment remedy if the percentage of fine-grained particles in the contaminated soil is greater than approximately 30 percent.

  – Reliability – Excavation, soil washing, and deed restrictions are effective over the long term and have been effectively implemented at other sites. Deed restrictions should prevent future residential exposure to contaminated soil at the site. Management of waste materials is limited to contaminated soil and no long-term environmental monitoring is required at the site. Pretreatment testing will confirm if soil washing can

achieve the CAOs. Some degree of long-term liability may be associated with disposal of the fine grained contaminated soil in an off-post landfill.

– Implementability – Excavation equipment is readily available. Subsurface utilities may possibly affect the implementation of Alternative 2, though the presence of such obstructions at the site is unlikely. A Subtitle C landfill for disposal of the fine grained soil is located within 100 of TEAD. Because this site is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

  Although the use of soil washing has been successfully implemented at other sites, the number of vendors with experience in using this treatment technology is limited. To meet the CAOs, approximately 4 to 5 weeks are required for excavation, soil washing, off-post transportation/ disposal, and backfilling.

– Safety – Alternative 2 poses minimal to moderate short-term risks to off-post residential communities and onsite workers. Residential communities may be exposed to the contaminated soil during transportation and off-post treatment/disposal. Onsite workers may be exposed to contaminated soil during excavation, soil washing, and other soil-handling activities. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

– Human health assessment – Excavation, soil washing, and deed restrictions of contaminated soil protect human health by preventing both short- and long-term soil exposure. Restricting future development of the site protects human health by preventing residential exposure. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

– Environmental assessment – This alternative further reduces the already low ecological risk at Building 611 of SWMU 54.

– Administrative feasibility – Alternative 2 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by treating the metals-contaminated soil and preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil that is shipped off post is transported in accordance with DOT regulations. The soil washing system includes a wet screening process to minimize fugitive dust emissions and a closed-loop water handling system to eliminate the need for onsite liquid

discharges. Because of these features, permits to control air emission or water discharges are not expected to be required.

– Cost – The estimated present worth cost of implementing Alternative 2 is $260,000. Table A-20 (Appendix A) presents the detailed cost estimate.

7.2.2.3 Alternative 3 – Excavation, Solidification/Stabilization, and Deed Restrictions. For Alternative 3, the metals contaminated soil are excavated using a backhoe, scraper, or other similar equipment. Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for cadmium and lead. Soil is excavated until the quantitative CAOs for cadmium and lead are met. An XRF field instrument may be used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 2 feet, resulting in a total volume of 156 yd^3. Under this alternative, the lead contaminated soil at the used oil dumpster location at the northwest corner of Building 611 (SWMU 46, Group B) shall also be excavated, which adds an additional volume of 4 yd^3.

The lead and cadmium contaminated soil is treated onsite by solidification/stabilization, followed by backfilling of the treated soil, and placement of a soil cover over the stabilized material. In the solidification/stabilization process, cement or other chemicals or a proprietary binding agent is used to solidify and stabilize the homogenized soil. A cement-based process is selected for this alternative because of its versatility in immobilizing both particulate and adsorbed lead. Pretreatment optimization, performed as part of the alternative, may indicate that another solidification/stabilization agent is more effective. TCLP is used to evaluate the effectiveness of stabilization. The stabilized soil that meets TCLP standards is then returned to the excavation area where it is allowed to cure in place.

The objective of solidification/stabilization is to treat the contaminated soil to below applicable regulatory levels (e.g., TCLP, unconfined compressive strength, and permeability). Pretreatment testing is required to evaluate the effectiveness of the technology and to obtain optimum design criteria. Confirmation sampling verifies the stabilization of the soil and that the regulatory levels have been met. A small amount of clean soil from an on-post borrow area is backfilled into excavated areas. A gravel cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Pretreatment optimization is required prior to final design of the solidification/stabilization alternative to evaluate the effectiveness of this technology on the metals-contaminated soil from the site, and to select the stabilization reagent formulation. This is to include TCLP tests to evaluate the ability of the solidification/stabilization process to convert the contaminated soil to a nonhazardous material in accordance with RCRA. The study is expected to produce information on the strength, durability, volume increase, and long-term integrity of the stabilized material, and on design criteria for the treatment process. For purposes of the CMS, it is assumed

that Portland cement is the primary reagent to be used, and that the volume increase due to treatment of the soil is 20 percent. Five year inspections – to include sample collection and analysis – are conducted to confirm the long-term effectiveness of the stabilization process.

Alternative 3 also includes the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 7.2.2.1. Deed restrictions on this area of SWMU 54 apply within the SWMU boundary presented on Figures 7-1 and 7-2 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 3 – excavation, solidification/stabilization, and deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, solidification/stabilization, and deed restrictions are likely to meet both the quantitative and qualitative CAOs developed for this site. This alternative complies with UAC R315-101-3, the "Principle of Non-Degradation," by treating the metals-contaminated soil, thereby preventing the migration of contaminants to other environmental media. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to these contaminants at the site. Alternative 3 is applicable to both site and contaminant characteristics and is likely to meet the identified CAOs with no decrease in effectiveness over time. Deed restrictions limit future exposure by preventing residential use of the site.

    This alternative requires pretreatment testing to confirm the effectiveness of solidification/stabilization for classifying the metals-contaminated soil as nonhazardous based on TCLP test results. Although solidification/stabilization is considered a permanent treatment process, there is a potential for the eventual breakdown of the material and release of contained metals. The pretreatment optimization is expected to more clearly quantify this potential.

  – Reliability – Excavation, solidification/stabilization, and deed restrictions are effective for remediating contaminated areas over the long term, and have been effectively implemented at other sites. Deed restrictions should prevent future residential exposure to contaminated soil at the site. Management of waste materials is limited to contaminated soil. Pretreatment testing will confirm if solidification/stabilization can achieve the CAOs. Some degree of long-term liability may be associated with return of the stabilized soil at the site. Five year

inspections are conducted to confirm the long-term effectiveness of the stabilization process.

- Implementability – Excavation equipment for this alternative is readily available. Because Alternative 3 requires excavation, subsurface utilities may possibly affect its implementation, though the presence of such obstructions at the site is unlikely. A limited number of vendors provide solidification/stabilization services. To meet the CAOs, approximately 4 to 5 weeks is required for excavation, stabilization, and backfilling. Because this site is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property.

- Safety – Alternative 3 poses minimal to moderate short-term risks to onsite workers who may be exposed to contaminated soil during excavation, stabilization, and other soil-handling activities. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

- Human health assessment – Excavation and solidification/stabilization of contaminated soil protect human health by preventing both short- and long-term soil exposure. Restricting future development of the site protects human health by preventing residential exposure. The residual risk remaining onsite for soil results from soil contamination at concentrations below industrial use CAOs but above residential use CAOs.

- Environmental assessment – This alternative further reduces the already low ecological risk at Building 611 of SWMU 54.

- Administrative feasibility – Alternative 3 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by treating the metals-contaminated soil and preventing future residential development at this site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 3 is $210,000. Table A-21 (Appendix A) presents the detailed cost estimate.

7.2.3 Comparative Analysis Of Corrective Measures Alternatives

Table 7-3 and the text below summarize the comparative analysis of the three corrective measures alternatives developed for Building 611 (SWMU 54).

- Technical criteria

TABLE 7-3

Comparative Analysis of Corrective Measures Alternatives
Sandblast Areas, Building 611 (SWMU 54) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost
	Performance	Reliability	Implementability	Safety				
1. Excavation, off-site treatment/disposal, and deed restrictions	High	High	High	Moderate	High	High	High	$120,000
2. Excavation, soil washing, and deed restrictions	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	$260,000
3. Excavation, solidification/ stabilization, and deed restrictions	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	$210,000

(a) Rankings indicate how well each alternative meets the evaluation criteria, relative to other alternatives.

- Performance – Alternative 1 (excavation, off-post treatment/disposal, and deed restrictions), Alternative 2 (excavation, soil washing, and deed restrictions), and Alternative 3 (excavation, solidification/stabilization, and deed restrictions) each meet both the qualitative and quantitative CAOs. However, Alternative 1 is rated high with respect to performance while Alternatives 2 and 3 are rated moderate because 2 and 3 require pretreatment testing.

- Reliability – Alternative 1 is rated high for reliability because it has been proven effective at other sites and does not require onsite O&M activities. Alternatives 2 and 3 are rated moderate because pretreatment testing is required for each to further evaluate their effectiveness and permanence, and 5-year site inspections are recommended to ensure the long-term effectiveness of the solidification/stabilization process.

- Implementability – Alternative 1 is easy to implement, and is rated high. Equipment and contractors for excavation, and treatment/disposal are readily available. Alternatives 2 and 3 are rated moderate because of the limited number of vendors capable of performing the treatment processes.

- Safety – Alternative 1 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for disposal. It presents short-term exposure to both onsite workers and offsite residential communities. Alternatives 2 and 3 require more onsite handling of contaminated soil than Alternative 1 due to soil washing or solidification/stabilization, but a lower volume of material is transported off-post; they are also rated moderate.

- Human health assessment – Alternatives 1, 2, and 3 are each rated high because they either remove contaminated soil from the site, or remove contaminants from soil that remains at the site.

- Environmental assessment – All three alternatives are rated high because they further reduce the already low ecological risk at Building 611.

- Administrative feasibility – Alternative 1 is rated high because it meets the requirements of UAC R315-101. While Alternatives 2 and 3 also meet these requirements, they are rated moderate because they may require a RCRA permit for treating hazardous waste.

- Cost – Of the three alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $120,000. The costs for Alternatives 2 and 3 are estimated at $260,000 and $210,000, respectively.

7.2.4 Recommended Alternative

Based on the comparative analysis presented in Section 7.2.3, Alternative 1 – excavation, off-post treatment/disposal, and deed restrictions – is the recommended alternative for Building 611 of SWMU 54 because:

- It meets the quantitative and qualitative CAOs, including protection of human health and the environment, and compliance with UAC R315-101-3, the "Principle of Non-Degradation."
- It has been demonstrated at other sites.
- It is reliable.
- It can be safely implemented.
- It can be implemented at a much lower cost than the other corrective measures alternatives.

7.3 BUILDING 637

7.3.1 Summary of RAs and CMS Work Plan

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at Building 637. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 54 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

Based on the Phase II RFI (SAIC, 1997), no ecological RA was necessary for SWMU 54 because there is no ecological habitat sufficient to support small mammals or larger vertebrates at this site.

The CMS Work Plan (Dames & Moore, 2001) identified benzo(a)anthracene and benzo(b)fluoranthene as industrial use COCs in surface soil; however, both COCs were detected at concentrations only slightly above CAOs and in only two samples. The EPC for benzo(a)anthrancene only slightly exceeds its CAO, and the EPC for benzo(b)fluoranthene is below its CAO. The CAO concentration corresponds to a cancer risk of 1×10^{-6}. Furthermore, even the maximum concentration of benzo(a)anthrancene and benzo(b)fluoranthene are less than two percent of their CAOs if a 10^{-4} risk level is considered acceptable. No COCs were identified in subsurface soil.

The CAOs for Building 637 are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, only management measures are evaluated for Building 637 at SWMU 54. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternative for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.

Table 7-4 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for Building 637 in the CMS Work Plan (Dames & Moore, 2001).

7.3.2 Detailed Evaluation of Corrective Measures Alternative

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer. Deed restrictions on the BRAC property are governed by the CCRs as discussed in Section 7.2.2.1. Deed restrictions on this area of SWMU 54 apply within the SWMU boundary presented on Figure 7-1 and as defined in Exhibit C of the CCRs and in the site management plan.

Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of Building 637 at SWMU 54 and also meet the CAOs developed in the CMS Work Plan (Dames & Moore, 2001). This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

  – Implementability – Because SWMU 54 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the

TABLE 7-4

Summary of Phase II RFI and CMS Work Plan
Sandblast Areas, Building 637 (SWMU 54)

Phase II RFI (SAIC, 1997)									CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)								Impacts to Groundwater	Ecological Risk	COCs	Corrective Measures Alternatives (b)
Residential Land Use Scenario (c)				Realistic Future Land Use Scenario (d)				None	Low	Surface soil: Benzo(a)anthracene (g) Benzo(b)fluoranthene(g)	***Deed restrictions***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (d)**				
Adult	**2×10^{-5}**	**100**	NE (f)	Industrial	2×10^{-6}	0.5	6				
Child	**1×10^{-5}**	**300**	9	Construction	2×10^{-7}	0.08	9				

(a) Risks, HIs, and blood lead levels that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, and 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the realistic land use scenario. Because HIs and blood lead levels are greater than 1, and 10 µg/dL, respectively, UAC R315-101-6(e) indicates corrective actions must be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Benzo(a)anthracene and benzo(b)fluoranthene were detected at concentrations only slightly above CAOs and in only two samples.

property. This alternative is technically and administratively feasible, and immediately meets the CAOs.

– Safety – Safety issues are not applicable because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure to the COCs in surface soil.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding Building 637.

- Administrative feasibility – This alternative meets the specified requirements of UAC R315-101 by preventing future residential development at this site.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-22 (Appendix A) presents the detailed cost estimate.

7.3.3 Recommended Corrective Measures Alternative

Based on the above evaluation, Alternative 1 – deed restrictions – is recommended as the preferred alternative for Building 637 at SWMU 54 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.

8.0 GRAVEL PIT (SWMU 56)

Section 8.0 evaluates corrective measures alternatives for the Gravel Pit (SWMU 56; Figure 8-1). Data from the CMS Work Plan (Dames & Moore, 2001), and the human health and ecological RA (SAIC, 1997) are also summarized below.

The Gravel Pit is a low-lying area of approximately 4 acres. It is located within the Maintenance Area of TEAD (Figure 8-1). This SWMU is part of the BRAC parcel and is designated for future industrial use. The pit is surrounded on the north, east, and south sides by a ridge that defines its perimeter. Residual piles of cobbles are located throughout the southern portion of the pit (SAIC, 1997). An approximately 2,000-ft^2 area of discolored soil – referred to as the "Burned Area" – is also located at the southern end of the pit.

The Gravel Pit was identified during an aerial photographic site analysis of the Maintenance Area. The photographs showed an area of disturbed ground located east of Building 699, along the northeast perimeter of the Depot. During a site walkover, vehicle components and containers were observed on the surface.

8.1 SUMMARY OF RAs AND CMS WORK PLAN

Risks were calculated seperately for the nonburned area soils and the Burned Area soils. The Phase II RFI (SAIC, 1997) identified unacceptable HIs for hypothetical future adult and child residents at the Nonburned Area of SWMU 56. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 56 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for current and future industrial workers and for future construction workers are below target values.

The Phase II RFI (SAIC, 1997) identified unacceptable risks and HIs for hypothetical future adult and child residents at the Burned Area of SWMU 56. In addition, the 95^{th} percentile blood lead level for the child resident in the Burned Area is greater than the CDC guidance level of 10 µg/dL. Therefore, according to EPA guidance and UAC R315-101-6(d), this area of SWMU 56 is included in the CMS process, and corrective measures must be evaluated. Risks and HIs for future construction workers, and risks for current and future industrial workers are below target values. However, the HIs for current and likely future industrial workers, and the 95^{th} percentile blood lead levels for future construction workers exceed target values. Therefore, active corrective measures are required.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant distributions in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

Based on evaluation of the concentrations of COPCs in soil and the levels of exposure to ecological receptors, the Phase II RFI (SAIC, 1997) determined that thallium posed a potential risk to vegetation and deer mice in the Nonburned Area of SWMU 56. The HQs for vegetation and deer mice were 17.3 and 144, respectively.

In the Burned Area of SWMU 56, the Phase II RFI (SAIC, 1997) determined that antimony, copper, lead, thallium, and zinc have HQs above the threshold of 10 for vegetation receptors. The HQ for thallium to deer mice also exceeded 10, but the value (40.6) is less than that of background (49.7).

Although the Phase II RFI (SAIC, 1997) identified potential moderate ecological risks based on vegetation HQ levels, a high degree of uncertainty is associated with the plant risks due to limited toxicological information. Furthermore, most plant toxicity studies are conducted on vegetation that would not survive in the desert environment, such as typical agricultural crops (e.g., lettuce, wheat, and rice). The estimated risks to plants at the Gravel Pit, as indicated by higher HIs, are highly uncertain because of the physiochemical differences (i.e., high clay content, high native mineral content) in arid desert soil at TEAD compared to soil from wetter climates, as well as species differences (as noted above). The SWERA commented that the site had an ecological habitat and some ecological risk may be present which is expected to be mitigated as part of the human risk remediation. The SWERA concluded that the site risks were low. Based on the conclusions of both reports the potential ecological risk at SWMU 56 is identified as moderate and no corrective measures are recommended to mitigate ecological risks.

The CMS Work Plan (Dames & Moore, 2001) identified no COCs at the Gravel Pit. However, corrective measures are evaluated for excavation of the Burned Area. The human health RA separately evaluated risks from the Burned and Nonburned Areas (SAIC, 1997); it demonstrated that removal of the Burned Area soil should reduce cancer risks to acceptable levels for all receptors. HIs are also reduced to acceptable levels for the current and reasonably anticipated future land use. Although for the Nonburned Area soil the HIs for residents appear to be elevated due to thallium, it is present in one sample at a concentration (25.1 µg/g) which is well below the comprehensive basewide background level (54 µg/g).

The estimated extent of soil in the Burned Area to be excavated – approximately 5,400 ft^2 to a depth of 2 feet – is based on the area shown in Figure 8-2. The total volume of soil is approximately 400 yd^3.

The CAOs for this area of SWMU 56 are:

- To ensure that – if the industrial land use changes in the future to residential or other use – appropriate measures are taken to adequately protect human health and the environment.

- To comply with UAC R315-101 and all its parts.

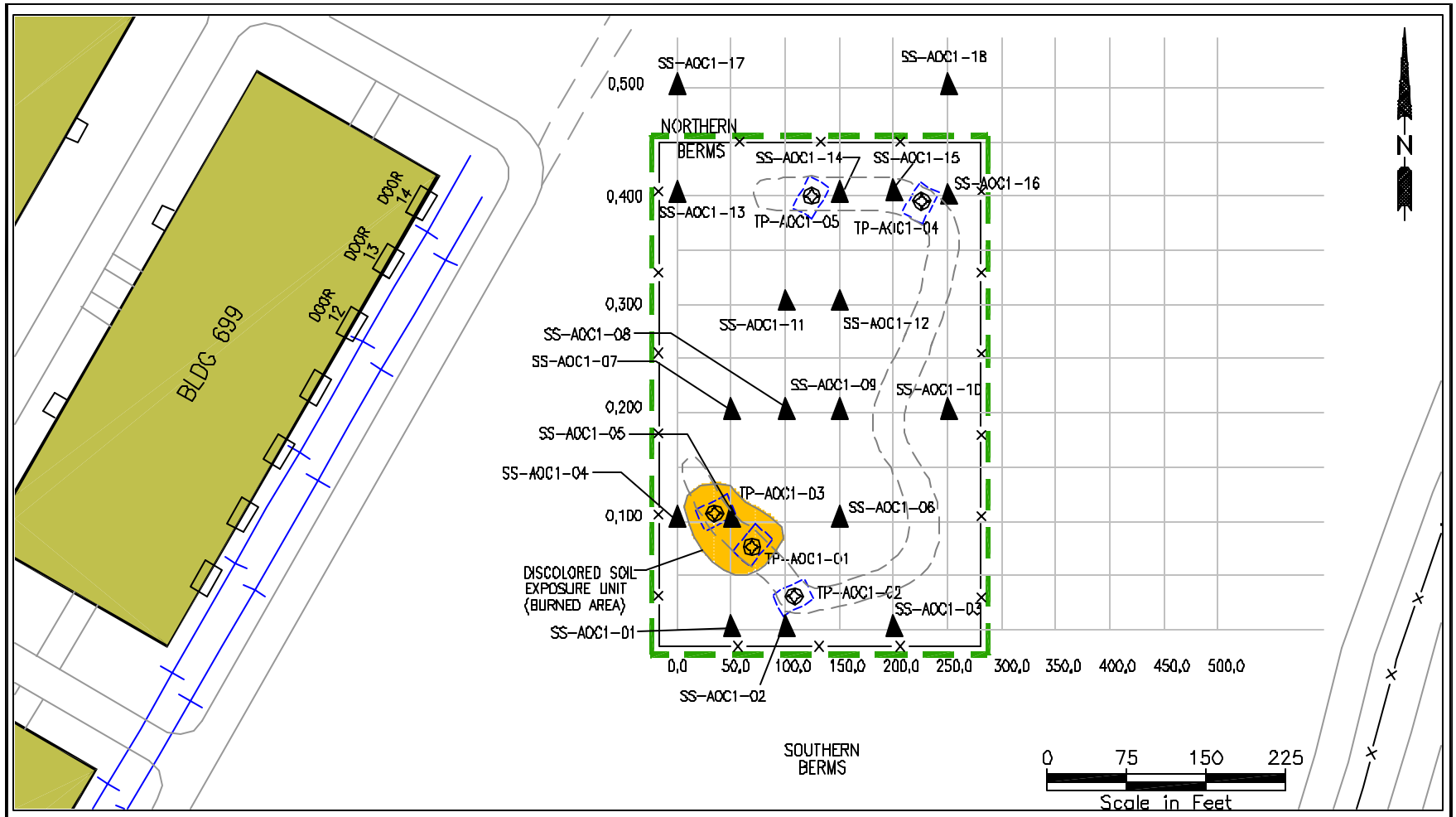

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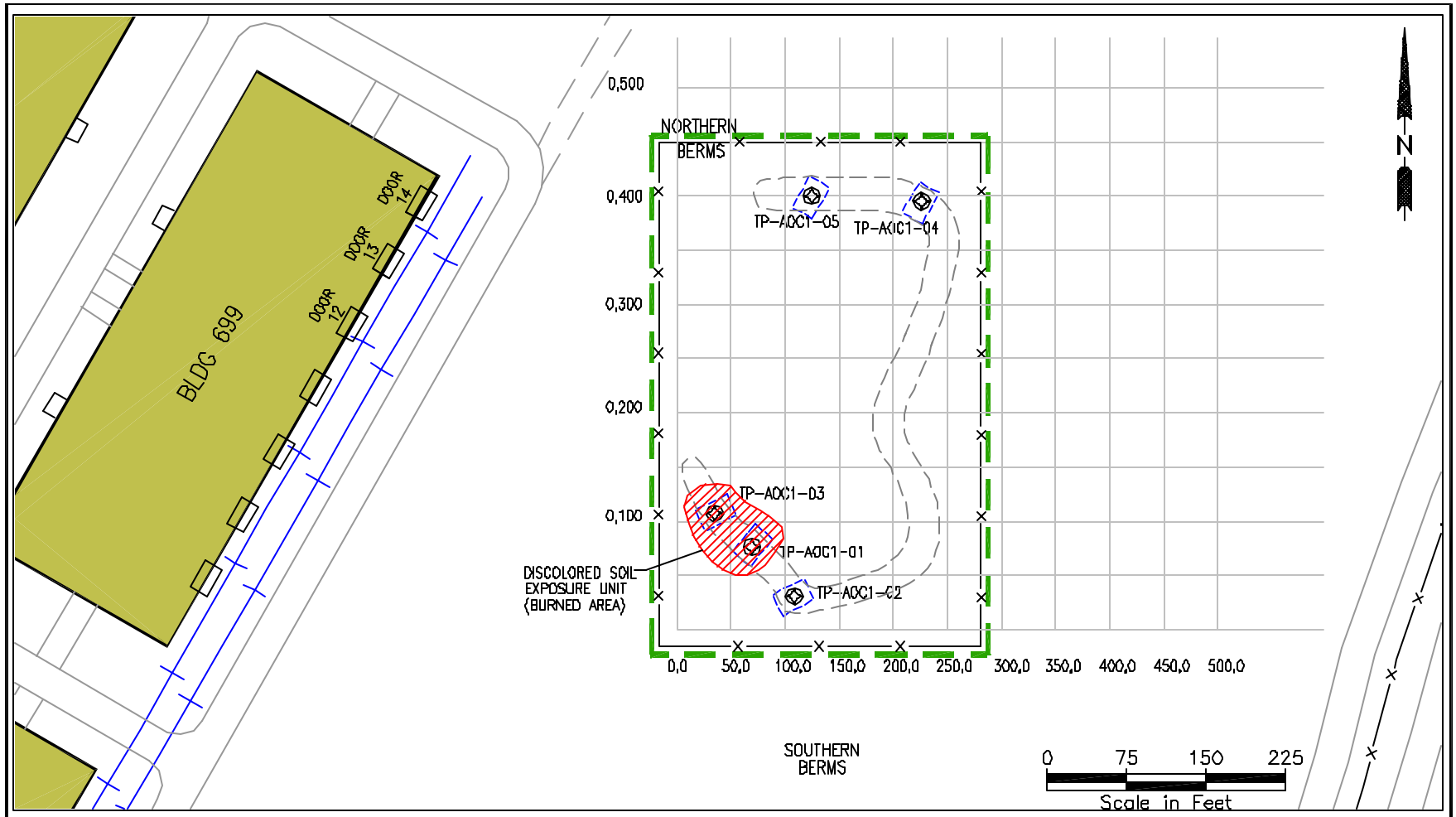
FIGURE 8-1
GRAVEL PIT
(SWMU 56)
TOOELE ARMY DEPOT



LEGEND

- APPROXIMATE AREA OF CONTAMINATION
- BUILDING
- FENCE
- RAILROAD
- SWMU BOUNDARY (APPROX.)
- APPROX. LOCATION OF CEMENT MONUMENT
- APPROX. TEST PIT LOCATION
- RIDGE LOCATION

SOURCE: RUST E&I, 1995

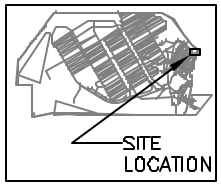


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FIGURE 8-2
APPROXIMATE AREA OF CONTAMINATION
AT THE GRAVEL PIT (SWMU 56)
TOOELE ARMY DEPOT

Based on the evaluation of risks and hazards to human health and the environment and regulatory requirements, two alternatives are evaluated for the Gravel Pit. The CMS Work Plan (Dames & Moore, 2001) identified the following corrective measures alternatives for this area:

Alternative 1: Deed restrictions
Impose deed restrictions to prevent residential development.
Alternative 2: Excavation and off-post treatment/disposal (Burned Area only)
Excavate discolored soil. Fill and compact with clean soil. Characterize, transport and treat/dispose of discolored soil off post in accordance with U.S. Army protocols and State and Federal regulations

Table 8-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for the burned area in the CMS Work Plan (Dames & Moore, 2001).

8.2 DETAILED EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

Section 8.2 evaluates the two corrective measures alternatives for the Gravel Pit.

8.2.1 Alternative 1 – Deed Restrictions

Alternative 1 is the application of deed restrictions to prevent future residential use of the site. These restrictions are legally binding and are incorporated into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.

Deed restrictions on the BRAC property are governed by the *Covenants, Conditions, and Restrictions* (CCRs) November 1998. The CCRs dictate that deed restrictions are enforceable by the United States of America, the Redevelopment Agency of Tooele City, and Transferee, and by other designated government agencies (State of Utah). This information is specified in the "Memorandum of Agreement Between the Department of Army, the State of Utah Department of Environmental quality, and the U.S. Environmental Protection Agency, Regarding Continuing Environmental Responsibility for Transferred Portions of the Tooele Army Depot" (December, 1998).

In addition to the existing CCRs, a site management plan will be delivered upon acceptance of the Decision Document. In this plan, the area subject to deed restrictions is surveyed and legally defined. This plan also describes the restrictions that apply to the SWMU and periodic inspections and monitoring to ensure the deed restrictions are being observed. The site management plan will become part of TEAD's RCRA Corrective Action and Post Closure Monitoring Permit. In addition, the RCRA Post Closure Permit shall be reviewed every 5 years.

TABLE 8-1

Summary of Phase II RFI and CMS Work Plan
Gravel Pit (SWMU 56)

Phase II RFI (SAIC, 1997)								**CMS Work Plan (Dames & Moore, 2001)**			
Human Health Risk Assessment (a)								**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Residential Land Use Scenario (c)				**Realistic Future Land Use Scenario (d)**				None	Moderate	None	Deed restrictions ***Excavated and off-post treatment/disposal (Burned Area only)***
	Risk	**HI**	**Blood Lead Level (e)**		**Risk**	**HI**	**Blood Lead Level (e)**				
Burned Area											
Adult	**7×10^{-5}**	**100**	NE (f)	Industrial	2×10^{-7}	**2**	9.5				
Child	**4×10^{-5}**	**400**	**19**	Construction	1×10^{-6}	0.5	**16**				
Nonburned Area											
Adult	3×10^{-7}	**80 (g)**	NE (f)	Industrial	5×10^{-8}	0.3	NE				
Child	2×10^{-7}	**200 (g)**	NE	Construction	5×10^{-9}	0.02	NE				

(a) Risks, HIs, and blood lead that are above comparison levels appear in bold type.
(b) The recommended corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the hypothetical future residential land use scenario. Because risks, HIs, or blood lead levels are greater than 1×10^{-6}, 1, or 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed.
(d) EPA guidance and UAC R315-101-5.2(b)(2) require evaluation of the realistic future land use scenario. Because HIs and blood lead levels are greater than 1 and 10 µg/dL, respectively, UAC R315-101-6(e) indicates that corrective actions must be evaluated.
(e) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(f) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).
(g) Elevated HIs due to thallium in soil at a concentration below the comprehensive basewide background level.

Deed restrictions on this area of SWMU 56 apply within the SWMU boundary presented on Figure 8-1 and as defined in Exhibit C of the CCRs and in the site management plan. Alternative 1 – deed restrictions – is evaluated as follows:

- Technical criteria

  – Performance – Deed restrictions limit future exposure by preventing residential use of the burned area of the Gravel Pit. However, deed restrictions do not meet CAOs developed in the CMS Work Plan (Dames & Moore, 2001) because unacceptable HIs for industrial workers and blood lead levels for construction workers remain onsite. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals for residential protection with no decrease in effectiveness over time.

  – Reliability – Deed restrictions are effective over the long term and have been implemented at many sites with positive results (see Appendix B, Section B.2.1 of the CMS Work Plan). No additional exposure should occur while the restrictions are in place. No O&M, management of waste materials, or long-term environmental monitoring is required.

  – Implementability – Because SWMU 56 is part of the BRAC parcel, this alternative requires the placement of legally binding restrictions on the property. This alternative is technically and administratively feasible.

  – Safety – Safety issues are not applicable, because no intrusive activities are required for implementation of deed restrictions.

- Human health assessment – Restricting future development of the site protects human health by preventing residential exposure but unacceptable exposure exists for industrial and construction workers.

- Environmental assessment – The deed restriction alternative has no effects on the ecological environment surrounding the Gravel Pit.

- Administrative feasibility – This alternative does not meet the specified requirements of UAC R315-101 because of unacceptable exposure for industrial and construction workers.

- Cost – The estimated present worth cost of implementing this corrective measures alternative is $12,000. Table A-23 (Appendix A) presents the detailed cost estimate.

8.2.2 Alternative 2 – Excavation and Off-post Treatment/Disposal

Alternative 2 includes excavation of approximately 400 yd^3 of metals contaminated soil to a depth of 2 feet bgs. The Burned Area has no industrial COCs but antimony and lead did exceed residential CAOs. Because the extent of contamination is estimated to be similar under industrial or residential CAO criteria, cleanup to residential CAOs is recommended, and deed restrictions will not be necessary. This recommendation is also based on the site location. Confirmatory samples are collected from the floor and each sidewall, and analyzed for antimony and lead. Excavation and confirmatory sampling continue until the quantitative CAOs for antimony and lead are achieved. Figure D-11 of Appendix D of the CMS Work Plan (Dames & Moore, 2001) presents the residential CAO exceedance locations. The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination at SWMU 56 suggest that the contaminants are not listed wastes. However, the contaminant data suggests that cadmium and lead could exceed TCLP regulatory levels and some of the soil may therefore exhibit a RCRA characteristic waste. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal. The excavated material is transported and manifested in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D landfill for disposal or to a local asphalt batching plant for incorporation into either hot- or cold-mix asphalt.

For purposes of this CMS, it is assumed that the excavated soil is shipped to a TSDF for pretreatment prior to disposal in a Subtitle C landfill. Clean soil from an on-post borrow site is backfilled into excavated areas. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 2 – excavation and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation and off-post treatment/disposal of contaminated soil meet the CAOs for SWMU 56 developed in the CMS Work Plan (Dames & Moore, 2001). Off-post treatment and disposal

reduce the toxicity and mobility of contaminants. This alternative is applicable to both site and contaminant characteristics, and meets the identified goals with no decrease in effectiveness over time.

- Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been implemented at many sites with positive results. Management of waste materials is limited to contaminated soil, and no long-term environmental monitoring is required. However, some degree of long-term liability may be associated with off-post disposal.

- Implementability – This alternative is technically and administratively feasible at this site. Excavation equipment is readily available, and both a Subtitle C landfill and a TSDF are located within 100 miles of TEAD. Because this alternative involves excavating soil to a depth of 2 feet bgs only, the presence of subsurface utilities does not significantly affect its implementation. Required equipment and materials are readily available. To meet CAOs, approximately 3 to 4 weeks are required for excavation, off-post transportation/disposal, and backfilling.

- Safety – Excavation and off-post treatment/disposal of surface soil pose minimal to moderate short-term threats to workers, off-post residential communities, and the environment. Potential threats from excavation are minimized by observing standard safety procedures (e.g., dust suppression, personal protective equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term exposure to the soil.

- Environmental assessment – This alternative reduces the risk to ecological receptors at SWMU 56.

- Administrative feasibility – This alternative complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101 by removing contaminated soil from the site. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 2 is $240,000. Table A-24 (Appendix A) presents the detailed cost estimate.

8.3 COMPARATIVE ANALYSIS OF CORRECTIVE MEASURES ALTERNATIVES

Table 8-2 and the text below summarize the comparative analysis of the two corrective measures alternatives developed for the Gravel Pit (SWMU 56).

- Technical criteria

  – Performance – Alternative 1 (deed restrictions) is rated low with respect to performance while, Alternative 2 (excavation, and off-post treatment/disposal) is rated high. Only Alternative 2 meets the CAOs. Under Alternative 1, unacceptable HIs for industrial workers and blood lead levels for construction workers remain at the Burned Area. Alternative 2 also has an advantage over Alternative 1 in terms of long-term effectiveness. Alternative 2 removes the contaminated soil to residential CAOs and so no deed restrictions are required.

  – Reliability – Alternatives 1 and 2 are rated high for reliability. Each alternative has been proven effective at other sites and does not require onsite O&M activities – though O&M and long-term monitoring are required at the off-post landfills.

  – Implementability – Both Alternatives 1 and 2 are easy to implement, and are rated high. Equipment and contractors for excavation and removal are readily available.

  – Safety – Alternative 1 is rated high because no intrusive activities are required. Alternative 2 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for treatment/disposal. It presents short-term exposure to both onsite workers and offsite residential communities.

  – Human health assessment – Alternative 1 is rated low because unacceptable exposure for current and likely future industrial and construction workers remain at the Burned Area. Alternative 2 is rated high because it removes contaminated soil from the site.

  – Environmental assessment – Alternative 2 is rated high because it reduces the ecological risk by removal of the Burned Area soil. Alternative 1 is rated moderate because although it does not affect the ecological risk, the risk was identified as moderate but not unacceptable.

  – Administrative feasibility – Alternative 1 is rated low while Alternative 2 is rated high. Alternative 2 meets the requirements of UAC R315-101 while unacceptable exposure would remain under Alternative 1. Alternative 1 also requires deed restrictions.

TABLE 8-2

Comparative Analysis of Corrective Measures Alternatives
Gravel Pit (SWMU 56) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost (b)
	Performance	Reliability	Implementability	Safety				
1. Deed restrictions	Low	High	High	High	Low	Moderate	Low	$12,000
2. Excavation, and off-post treatment/disposal	High	High	High	Moderate	High	High	High	$240,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

– Cost – Of the two alternatives, Alternative 1 is the least costly – with an estimated total present worth cost of $12,000. The cost for Alternative 2 is estimated at $240,000.

8.4 RECOMMENDED CORRECTIVE MEASURES ALTERNATIVE

Based on the above evaluation, Alternative 2 – excavation and off-post treatment/disposal – is recommended as the preferred alternative for SWMU 56 because:

- It meets the requirements of UAC R315-101.
- It has been demonstrated at other sites.
- It is reliable and implementable.
- Removal of the Burned Area soil results in acceptable industrial and residential risk levels.
- Removing soil to meet residential risk levels may increase the value of SWMU 56 as well as the nearby off-base land to the east.

9.0 SKEET RANGE (SWMU 57)

Section 9.0 evaluates corrective measures alternatives for the Skeet Range (SWMU 57; Figure 9-1). Data from the CMS Work Plan (Dames & Moore, 2001), the human health and ecological RA (SAIC, 1997) are also summarized below.

SWMU 57 is located in the northern portion of the Administration Area of TEAD within the BRAC parcel, and is identified for future residential use. The Skeet Range has been used for skeet and trap shooting since 1978. At the time of the RFI, skeet shooting consisted of occasional competitions and infrequent target practice (SAIC, 1997). TEAD records indicate that the use of lead shot was always prohibited; however, there is no documentation to indicate that this regulation was enforced. As a consequence, lead contamination was of concern in the impact area. In addition, numerous clay target fragments, which are suspected to contain PAHs (SAIC, 1997), have accumulated in the impact area.

9.1 SUMMARY OF RAs AND CMS WORK PLAN

During the Phase II RFI (SAIC, 1997), XRF was used to screen for areas of lead contamination. Confirmatory soil sampling and analysis identified one area with lead at unacceptable levels. In addition, visual screening for clay target fragments identified probable locations of elevated PAHs. Soil samples were collected in these locations and analyzed for SVOCs to identify areas with unacceptable levels of PAHs.

Risks were calculated separately for soils with lead shot and for soils with lead shot removed. Under both scenarios, the Phase II RFI (SAIC, 1997) identified risks greater than 1×10^{-6}, HIs greater than 1, and blood lead levels greater than 10 μg/dL under the future residential land use scenario. Because the likely future use of SWMU 57 is residential, EPA guidance and UAC R315-101-1(b)(4) require the evaluation of corrective measures. Because the risks and HIs exceed 1×10^{-4} and 1, respectively, for the likely future residential exposure, EPA guidance and UAC R315-101-6(e) also require the evaluation of corrective actions.

Results of the SESOIL computer model indicate that no impacts to groundwater are expected based on contaminant distributions in soil (SAIC, 1997). Moreover, the infiltration to groundwater is extremely low due to low precipitation rates, high evaporation rates, and depth to groundwater.

The Phase II RFI (SAIC, 1997) determined that lead in soil poses a potentially unacceptable ecological risk to vegetation, deer mice, jackrabbits, and kestrels at SWMU 57. HQs due to lead for each of these receptors were substantially above the background levels. Antimony and arsenic in soil were also determined to exceed HQ thresholds for vegetation, deer mice, jackrabbits, and kestrels. Several organic constituents – particularly PAHs – were also detected in soil; however, they were not evaluated with respect to ecological impacts because of the lack of toxicity reference values. Based on the ecological risk estimates

presented in the Phase II RFI, it is recommended that corrective measures be considered for mitigating ecological risk at the Skeet Range, in addition to human health risks. As discussed in Section 9.2, the evaluation of corrective measures alternatives for SWMU 57 includes assessment of the ability of each alternative to reduce ecological risks to acceptable levels.

The CMS Work Plan (Dames & Moore, 2001) identified COCs by comparing the maximum concentration of each COPC identified in the Phase II RFI Report (SAIC, 1997) to the respective quantitative CAO. Using residential CAOs, antimony, arsenic, and lead were identified as COCs in the northern portion of the Skeet Range. Additionally, six PAHs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene – were identified as COCs in the southern portion of the Skeet Range. The CMS Work Plan estimated the extent of contamination at SWMU 57, as shown on Figures 9-2 and 9-3 for metals and PAHs, respectively. Also highlighted are the COC locations that helped define the areas and volumes of contaminated soil.

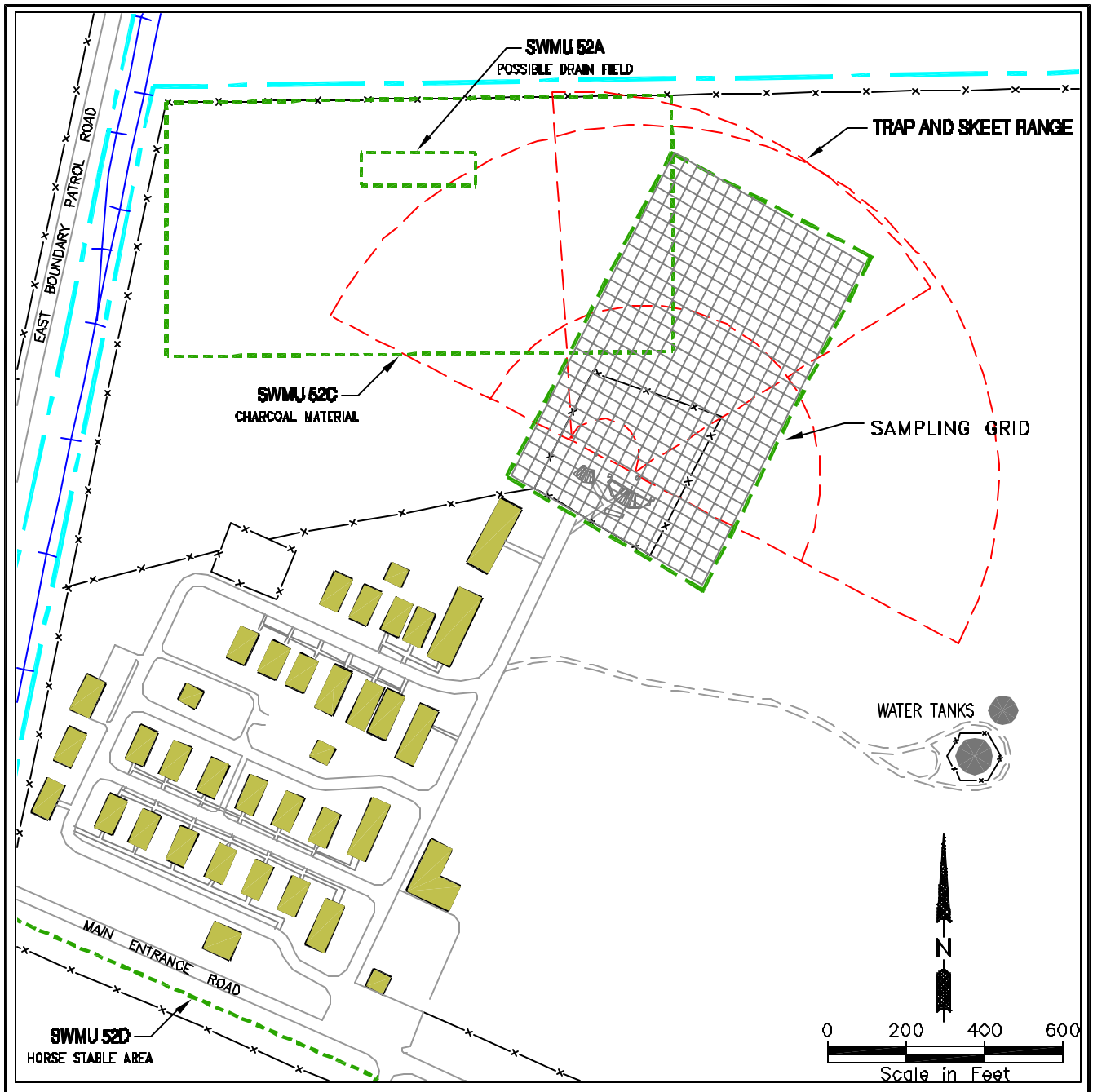
Based on the soil sampling data presented in detail in the Phase II RFI (SAIC, 1997), the contaminated soil is assumed to extend to an average depth of 1 foot bgs for both the metals- and PAH-contaminated areas. The total areas containing soil contaminated with metals and PAHs are estimated to be 52,000 ft^2 and 43,000 ft^2, respectively. The total volumes of soil contaminated with metals and PAHs are approximately 1,930 yd^3 and 1,590 yd^3, respectively. The actual areas and depths of contamination will be determined by confirmatory sampling to be conducted when the selected corrective measures are implemented.

In addition to the previously discussed quantitative CAOs based on future residential use of the site, the CMS Work Plan (Dames & Moore, 2001) presented qualitative CAOs for SWMU 57 to comply with UAC R315-101, as follows:

- To protect other media from further degradation (i.e., to ensure that levels of contamination do not increase beyond existing levels, per UAC R315-101-3).

- To comply with UAC R315-101 and all its parts.

The CMS Work Plan (Dames & Moore, 2001) identified three alternatives to address metals and PAHs in surface soil at the Skeet Range, as noted below:



LEGEND

- FENCE
- RAILROAD
- BUILDING
- TEAD BOUNDARY
- SWMU BOUNDARY (APPROX.)

SOURCE: RUST E&I, 1995

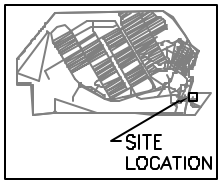


FIGURE 9-1
SKEET RANGE (SWMU 57)
TOOELE ARMY DEPOT

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SB-57-16	
0 ft	
Lead	56,000.0

SS-57-055	
0 ft	
Antimony	2,750.0

SB-AOC2-03	
0 ft	
Arsenic	1,700.0
Lead	160,000.0
1 ft	
Arsenic	270.0
Lead	79,000.0

SB-57-17	
0 ft	
Lead	460.0
0 ft (DUP)	
Lead	410.0

SS-57-18	
0 ft	
Lead	86,000.0

SS-57-025	
0 ft	
Lead	420.0

SS-57-068	
0 ft	
Lead	82,000.0

SB-57-14	
0 ft	
Lead	69,000.0

SS-57-098	
0 ft	
Lead	630.0

SB-AOC2-12	
0 ft	
Benzo(a)anthracene	1.1
Benzo(b)fluoranthene	1.5

SS-57-109	
0 ft	
Lead	66,000.0

SS-57-058	
0 ft	
Lead	98,000.0

SB-AOC2-06	
0 ft (DUP)	
Arsenic	530.0

SB-AOC2-01	
0 ft	
Antimony	3,040.0
Arsenic	840.0
Lead	150,000.0

SS-57-018	
0 ft	
Lead	86,000.0

SB-57-19	
0 ft	
Lead	400.0

SS-57-074	
0 ft	
Lead	80,000.0

SS-57-114	
0 ft	
Lead	470.0

SS-57-072	
0 ft	
Lead	440.0

SS-57-132	
0 ft	
Lead	250,000.0

SS-57-102	
0 ft	
Lead	420.0

SS-57-119	
0 ft (DUP)	
Lead	70,000.0
Arsenic	780.0

SS-57-145	
0 ft	
Antimony	3,840.0

SS-57-116	
0 ft	
Lead	590.0

SS-57-130	
0 ft (DUP)	
Lead	92,000.0

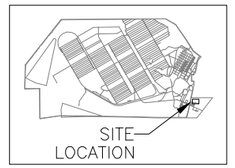
SS-57-115	
0 ft	
Lead	89,000.0

DISTANCE (METERS)

LEGEND

- BUILDING
- FENCE
- SWMU BOUNDARY (APPROX.)
- METAL SAMPLES COLLECTED AT GROUNDSURFACE (INITIAL PHASE II SAMPLING)
- METAL SAMPLES COLLECTED AT GROUNDSURFACE AND 1 FOOT BGS (INITIAL PHASE II SAMPLING)
- SVOC SAMPLES COLLECTED AT GROUNDSURFACE (INITIAL PHASE II SAMPLING)
- LEAD SURFACE SOIL SAMPLE (SUPPLEMENTAL SAMPLING)
- LEAD SAMPLES COLLECTED AT GROUNDSURFACE AND 1 FOOT BGS (SUPPLEMENTAL SAMPLING)
- LEAD, ANTIMONY, AND ARSENIC SURFACE SOIL SAMPLE (SUPPLEMENTAL SAMPLING)
- APPROXIMATE AREA OF CONTAMINATION

CONCENTRATIONS IN ug/g



N

0 50 100 200

SCALE: 1" = 100'

FIGURE 9-2
COC LOCATIONS AND APPROXIMATE AREA OF CONTAMINATION AT THE SKEET RANGE (SWMU 57) NORTH AREA TOOELE ARMY DEPOT

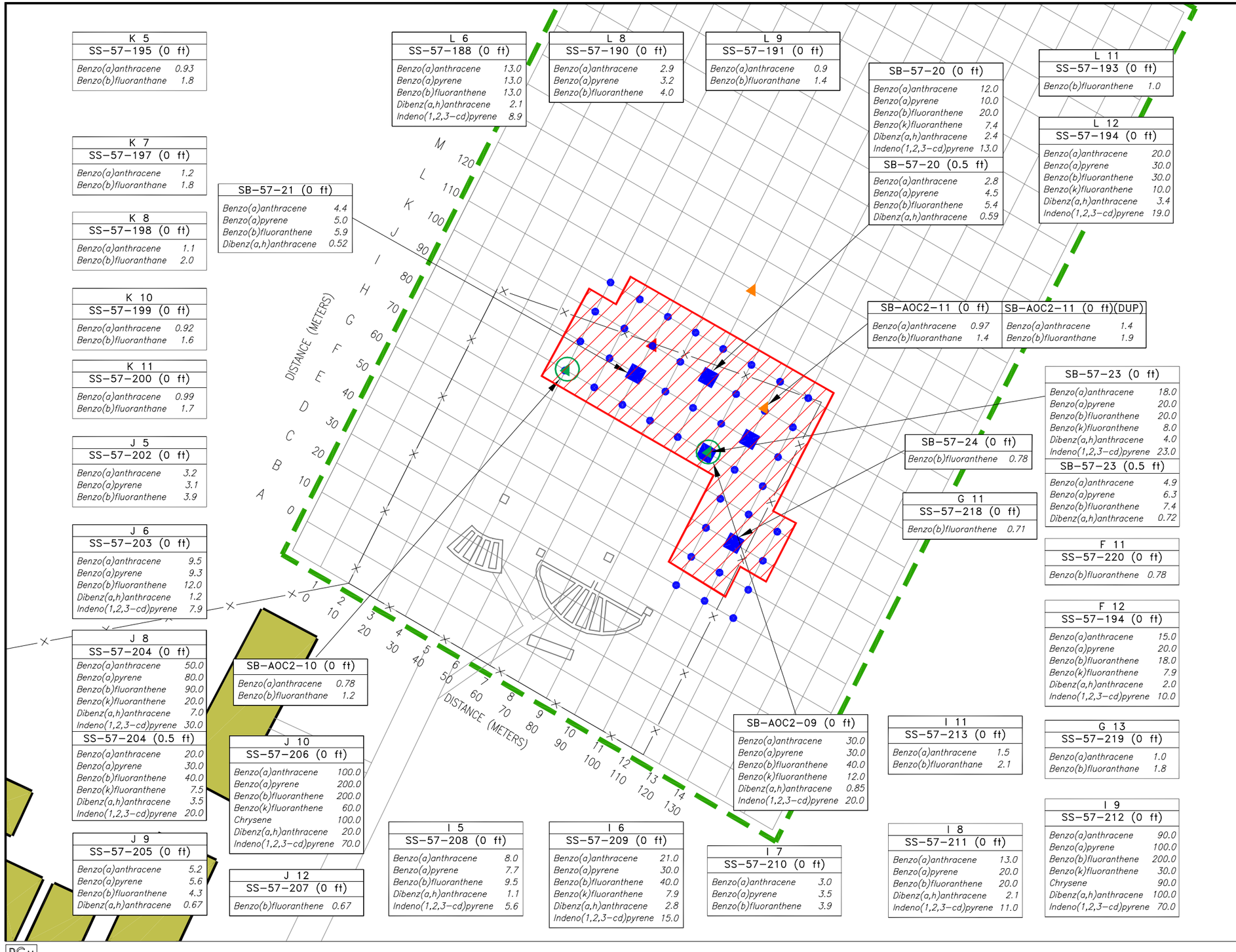


FIGURE 9-3
COC LOCATIONS AND APPROXIMATE AREA OF CONTAMINATION AT THE SKEET RANGE (SWMU 57) SOUTH AREA TOOELE ARMY DEPOT

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Alternative 1: Excavation and off-post treatment/disposal
Excavate contaminated soil Fill and compact with clean soil Characterize by TCLP analysis, transport, and treat/dispose of excavated soil off post in accordance with U.S. Army protocol and Federal and State regulations
Alternative 2: Excavation, soil washing, and off-post treatment/disposal
Excavate contaminated soil Separate lead shot from metals-contaminated soil Treat soil with dissolved phase metals by on-site solidification/stabilization Ship recovered lead shot to off-post lead reclamation facility Dispose of treated metals contaminated soil and PAH-contaminated soil off post in accordance with U.S. Army protocol and Federal and State regulations
Alternative 3: Excavation, solidification/stabilization, and off-site treatment/disposal
Excavate contaminated soil Treat metals-contaminated soil on post by solidification/ stabilization Characterize by TCLP analysis, transport, and dispose of solidified soil and PAH-contaminated soil off post in accordance with U.S. Army protocol and Federal and State regulations

Table 9-1 summarizes the risks to human health and the environment evaluated in the Phase II RFI (SAIC, 1997) and the corrective measures alternatives identified for SWMU 57 in the CMS Work Plan (Dames & Moore, 2001).

9.2 DETAILED EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

This section evaluates the three corrective measures alternatives for the Skeet Range (SWMU 57). Each alternative includes excavation and off-post disposal of the PAH-contaminated soil, in combination with off-post disposal or treatment technologies for the metals-contaminated soil.

9.2.1 Alternative 1 – Excavation and Off-Post Treatment/Disposal

As part of Alternative 1, both the metals- and PAH-contaminated soil are excavated using a backhoe, scraper, or other similar equipment. Figure 9-2 shows the metals-contaminated areas (north area). The analytical data presented in the Phase II RFI (SAIC, 1997) indicate that most of the metals contamination at SWMU 57 is limited to shallow soil, at depths of 6 inches or less.

Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for lead, antimony, and arsenic. Soil is excavated, until the quantitative CAOs for lead, antimony, and arsenic are met. An XRF field instrument may be

TABLE 9-1

Summary of Phase II RFI and CMS Work Plan
Skeet Range (SWMU 57)

Phase II RFI (SAIC, 1997)						CMS Work Plan (Dames & Moore, 2001)	
Human Health Risk Assessment (a)				**Impacts to Groundwater**	**Ecological Risk**	**COCs**	**Corrective Measures Alternatives (b)**
Realistic Future Residential Land Use Scenario (c)				None	Potentially unacceptable	Surface soil: Antimony Arsenic Lead Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo (k)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	***Excavation and off-post treatment/ disposal*** Excavation, soil washing, and off-post treatment/disposal Excavation, solidification/stabilization, and off-post treatment/ disposal
	Risk	**HI**	**Blood Lead Level (d)**				
Soil (including lead shot)							
Adult	**2×10^{-1}**	**1,000**	NE (e)				
Child	**9×10^{-2}**	**3,000**	**72**				
Soil (lead shot removed)							
Adult	**1×10^{-3}**	**7**	NE (e)				
Child	**7×10^{-4}**	**20**	**20**				

(a) Risks, HIs, and blood lead levels that are above comparison levels appear in bold type.
(b) The preferred corrective measures alternative appears in bold italic type.
(c) EPA guidance and UAC R315-101-5.2(b)(1) require evaluation of the residential land use scenario. Because risks, HIs, and blood lead levels are greater than 1×10^{-6}, 1, and 10 µg/dL, respectively, EPA guidance and UAC R315-101-6(c)(3) state that a CMS must be performed. UAC R315-101-5.2(b)(2) also requires evaluating the actual or potential land use scenario. Because risks, HIs, and blood lead levels are greater than 1×10^{-4}, 1, and 10 µg/dL, respectively, under the realistic future residential land use scenario, UAC R315-101-6(e) indicates that corrective actions must be evaluated.
(d) Blood lead levels are expressed as micrograms per deciliter (µg/dL) for 95 percent of the population. The CDC defines a limit of 10 µg/dL.
(e) NE = pathway incomplete or not evaluated; see CMS Work Plan (Dames & Moore, 2001).

used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 1 foot, resulting in a total volume of 1,930 yd^3.

Figure 9-3 shows the PAH-impacted area of SWMU 57 (south area). The PAH-contaminated soil is also excavated to an assumed average depth of 1 foot; the volume of the excavated soil is estimated to be 1,590 yd^3. Confirmatory soil samples are again collected from the floor and sidewalls of the excavation, and analyzed for PAHs. Excavation and confirmatory sampling continue until the quantitative CAOs for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are met.

The excavated soil undergoes a soil profile analysis to determine if the soil exhibits a listed or characteristic RCRA hazardous waste. A preliminary review of the site contaminants and potential waste processes contributing to the contamination at SWMU 57 suggest that the COCs in soil are a result of normal application of lead shot and clay targets and are not listed wastes. However, the contaminant data suggests that arsenic and lead in the north area will exceed TCLP regulatory levels and the north area soil will therefore exhibit a RCRA characteristic waste. Some of the south area soil may also exceed TCLP levels. A final waste determination will be made during the corrective action phase. A review of other regulations (e.g., State of Utah, DOT) and additional testing (e.g., TCLP) will be necessary to make this determination.

- If the excavated soil is classified as containing a hazardous waste in accordance with RCRA or other applicable criteria, it is transported to an off-post Subtitle C landfill for direct disposal (if contamination concentrations meet LDR guidelines), or to a TSDF for treatment prior to disposal. The excavated material is transported in compliance with applicable regulations.

- If the soil profile analysis results are acceptable, the material is transported to an off-post Subtitle D nonhazardous waste landfill for disposal. This soil could also potentially be reused by incorporation into asphalt or road base material.

Based on the relatively high concentrations of lead in the metals-contaminated soil (north area), it is assumed that this soil is classified as a hazardous waste in accordance with RCRA and State of Utah regulations. Therefore, the metals-contaminated soil is transported to a off-post TSDF, where it is pretreated by solidification/stabilization prior to placement in the landfill. Solidification/stabilization processes typically employ a variety of agents, such as cement, fly ash, lime-based materials, or other additives. These processes will reduce contaminant mobility and prevent the metals from leaching out of the stabilized soil.

Because most of the lead and other metals detected in the soil at SWMU 57 are contained in the lead pellets associated with skeet shooting, the soil is solidified to produce a soil cement material. (Chemical stabilization is not expected to immobilize the lead present in the pellets.) Depending on the agents used, the solidification/stabilization process may be

effective in chemically immobilizing some of the lead and other metals that may have migrated to the soil as a result of weathering and dissolution of the lead pellets.

Although the lead shot is not removed, the stabilized soil is expected to pass LDR and RCRA characteristic waste criteria. A soil sample was submitted to Safety-Kleen which they stabilized and conducted a soil profile analysis. Based on this analysis, Safety-Kleen has approved acceptanced of the metals-contaminated soil. Treated soil which fails criteria will be further solidified/stabilized before placement in the landfill.

For the purposes of this CMS and based on the analytical data presented in the Phase II RFI (SAIC, 1997), the PAH-contaminated soil (south area) at the Skeet Range is assumed to be classified as nonhazardous according to RCRA and State of Utah regulations. For cost estimating purposes the soil is assumed to be disposed at an off-post Subtitle D nonhazardous waste landfill. However, beneficial reuse of the soil in asphalt or road base could lower costs and should also be considered during the design phase.

Both the metals- and PAH-contaminated soil excavated and removed from the site is transported and manifested in compliance with applicable regulations. Clean soil from an on-post borrow site is backfilled into each of the excavated areas. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 1 – excavation and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation and off-post treatment/disposal of contaminated soil complies with UAC R315-101-3, the "Principle of Non-Degradation," by preventing future migration of metals and PAHs from soil to other environmental media at the site. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to these contaminants at SWMU 57. This alternative is applicable to both site and contaminant characteristics. Because contaminants are physically removed from the site, the quantitative CAOs are met with no decrease in effectiveness over time. Before landfill disposal, stabilization will need to be performed at the TSDF. Soil profile results conducted by Safety-Kleen show that the stabilized soil can be disposed in a landfill.

  – Reliability – Excavation and off-post treatment/disposal are effective over the long term and have been effectively implemented at other sites. Alternative 1 eliminates future residential exposure to contaminated soil at the site. Management of waste materials is limited to contaminated soil and no long-term environmental monitoring is required. Some degree of long-term liability may be associated with the disposal of contaminated soil in an off-post landfill or with its use in asphalt products or road base.

- Implementability – Excavation equipment for this alternative is readily available. A Subtitle C landfill is located within 100 miles of TEAD. In addition, Subtitle D landfills are located within 100 to 200 miles of TEAD, and an asphalt batching plant is located within approximately 15 miles of TEAD. To meet the CAOs, approximately 8 to 10 weeks are required for excavation, off-post transportation/disposal, and backfilling.

- Safety – Alternative 1 poses moderate short-term risks to off-post residential communities and onsite workers. Residential communities may be exposed to contaminated soil during transportation and off-post treatment/disposal of the soil. Onsite workers may be exposed to contaminated soil during excavation and soil-handling. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

- Human health assessment – Excavation and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term soil exposure.

- Environmental assessment – Excavation and off-post disposal of contaminated soil reduce the risk to ecological receptors by removing the contaminated soil from the site. Alternative 1 reduces the initial ecological risk by 97 to 100 percent for the various receptors at SWMU 57. Some residual risk remains for vegetation (exposure quotients (EQs) of 4 and 3.1 for arsenic and lead, respectively) and for the deer mouse (EQs of 1.7 and 1.2 for antimony and lead, respectively). Based on the conservative assumptions used in the ecological RA (SAIC, 1997), which generally overestimate exposure, these residual risks are considered to be acceptable.

- Administrative feasibility – Alternative 1 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by removing the contaminated soil from the site. Because the soil containing lead, antimony, arsenic, and PAHs above the CAOs is excavated and removed from SWMU 57, this alternative meets the human health risk criteria under UAC R315-101-6. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with U.S. DOT regulations.

- Cost – The estimated present worth cost of implementing Alternative 1 is $1,400,000. The estimate assumes disposal of the metals-contaminated soil at a Subtitle C hazardous waste landfill following pretreatment at the landfill by solidification/stabilization. The PAH-contaminated soil is disposed at an off-post Subtitle D landfill. Table A-25 (Appendix A) presents the detailed cost estimate.

9.2.2 Alternative 2 – Excavation, Soil Washing, and Off-Post Treatment/Disposal

For Alternative 2, both the metals- and the PAH-contaminated soil are excavated using a backhoe, scraper, or other similar equipment. Figure 9-2 shows the metals-contaminated areas (north area). The analytical data presented in the Phase II RFI (SAIC, 1997) indicate that most the metals contamination at SWMU 57 is limited to shallow soil, at depths of 6 inches or less.

Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for lead, antimony, and arsenic. Soil is excavated until the quantitative CAOs for lead, antimony, and arsenic are met. An XRF field instrument may be used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 1 foot, resulting in a total volume of 1,930 yd^3.

Based on the analytical data presented in the Phase II RFI (SAIC, 1997), the lead shot pellets from skeet shooting account for most of the metals COCs detected in soil at SWMU 57.

For Alternative 2, the excavated soil is treated by a soil washing process designed specifically to remove particles such as lead shot. This technology is based on conventional gold mining and mineral processing equipment, which combine physical and gravity separation. Prior to soil washing, the excavated soil from the metals-contaminated area is blended and stockpiled. This soil is then passed through a series of wet screens to physically separate oversized material such as plant roots, rocks, and larger sized gravel and soil particles from the smaller soil fractions and the lead shot pellets, which are typically 0.08 or 0.09 inch in diameter. The undersized material is then separated into concentrated lead shot and gravel/soil streams by gravity separation in a series of jigs, hydroclones, and other similar devices. Tapwater is the liquid medium used in both the wet screening and gravity settling equipment. The high density of the lead pellets enhances the efficiency of the gravity settling processes. The recovered lead pellets are shipped off post to a lead reclamation facility.

Following lead shot removal, the soil will be analyzed for total concentration and TCLP for the CAOs. Soil that meets LDR treatment requirements and is no longer RCRA characteristic is then backfilled into the excavated areas or used as fill material on-base.

The smaller size soil fractions will contain dissolved metals which may need additional treatment to achieve RCRA TCLP requirements. As an option for additional treatment following lead shot removal, dissolved metals could be separated from the soil by applying an acid leach to the soil. The metal and soil streams are then dewatered and the soil is chemically neutralized (i.e., lime addition). The washed soil is stockpiled prior to being sampled and tested to ensure that the quantitative CAOs have been achieved. The cleaned soil is then backfilled into the excavated areas or used as fill material on-base. Acid leaching does, however, have several drawbacks. Acid leaching would require testing to determine if it could achieve cleanup goals. Acid leaching requires a significant increase in on-site

equipment. Following acid leaching, the soil must be dewatered and the water treated or disposed. Acid leaching to remove dissolved metals from soil has been implemented at other sites, but the number of vendors are limited and the treatment goals may be difficult to achieve. The handling and storage of acid also complicates implementation. The cost for acid leaching treatment ranges between $80 to $130 per ton of soil. Because of the high cost and operational difficulties, acid leaching is not evaluated further for secondary treatment.

Instead, soil with dissolved lead is treated onsite by solidification/stabilization, and the stabilized waste used as construction material on-base or transported to an off-post Subtitle C or D landfill for final placement. Solidification/stabilization processes typically employ a variety of agents, such as cement, fly ash, lime-based materials, or other additives. Some processes reduce contaminant mobility by physically incorporating the contaminants in a solid matrix, thereby reducing contact between the contaminants and infiltration or runoff, while other processes chemically bind the constituents in the solidified matrix.

Pretreatment testing is required prior to final design of the lead shot removal and solidification/stabilization systems to evaluate the effectiveness of these technologies on the metals-contaminated soil from SWMU 57, and to select and optimize the stabilization reagent formulation. The pretreatment optimization is to include TCLP tests to evaluate the ability of the solidification/stabilization process to convert the contaminated soil to a nonhazardous material in accordance with RCRA.

Figure 9-3 shows the PAH-contaminated soil (south area), which is excavated to an assumed average depth of 1 foot; the volume of the excavated soil is estimated to be 1,590 yd^3. Confirmatory soil samples are again collected from the floor and sidewalls of the excavation, and analyzed for PAHs. Excavation and confirmatory sampling continue until the quantitative CAOs for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are met.

As discussed in Section 9.2.1, soil profile analyses (including total waste and TCLP tests) are conducted for the PAH-contaminated soil to determine where the excavated soil may be properly disposed. For the purposes of this CMS and based on the analytical data presented in the Phase II RFI (SAIC, 1997), the south area soil is assumed to be classified as nonhazardous according to RCRA and State of Utah regulations. For cost estimating purposes the soil is assumed to be disposed at an off-post Subtitle D nonhazardous waste landfill. However, beneficial reuse of the soil in asphalt or road base could lower costs and should also be considered during the design phase. Soil which fails TCLP is disposed as hazardous as discussed in Section 9.2.1. The excavated PAH-contaminated soil is transported and manifested in compliance with applicable regulations.

Clean soil from an on-post borrow site is backfilled into the excavated area. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 2 requires pretreatment testing to evaluate the effectiveness of this technology on soil from SWMU 57 and to develop the optimal process design criteria.

Alternative 2 – excavation, soil washing, and off-post treatment/disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, soil washing, and off-post treatment/disposal of contaminated soil are likely to meet both the quantitative and qualitative CAOs developed for SWMU 57. This alternative complies with UAC R315-101-3, the "Principle of Non-Degradation," by treating metals-contaminated soil and removing PAH-contaminated soil from the site, thereby preventing the future migration of metals or PAHs from soil to other environmental media. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to these contaminants at the site. Alternative 2 is applicable to both site and contaminant characteristics. Because contaminants are physically removed from SWMU 57, the quantitative CAOs are expected to be met with no decrease in effectiveness over time.

    A pretreatment test must be conducted to confirm the effectiveness of lead shot separation for achieving the quantitative CAOs for lead, antimony, and arsenic. Following lead shot removal, soil fractions without dissolved lead should meet cleanup objectives and not require further treatment. The smaller size soil fraction will likely require additional treatment by on-site solidification/stabilization followed by landfill disposal. The fraction of soil with dissolved lead may be a significant percent of the total soil volume. Pretreatment testing will be necessary to determine if these processes can achieve CAOs.

  – Reliability – Excavation, soil washing, and off-post treatment/disposal are effective over the long term and have been effectively implemented at other sites. Alternative 2 eliminates future residential exposure to contaminated soil at the site. Management of waste materials is limited to contaminated soil and no long-term environmental monitoring is required at SWMU 57. Strict controls and QA/QC will be necessary to ensure that soil which only receives lead shot removal has meet regulatory requirements and is not later contaminated by soil which requires an acid leach. Pretreatment testing will confirm if soil washing and/or solidification can achieve the CAOs. Some degree of long-term liability may be associated with disposal of the contaminated soil in an off-post landfill or with its use in asphalt or road base products.

– Implementability – Excavation equipment is readily available. Subsurface utilities may possibly affect the implementation of Alternative 2, though the presence of such obstructions at the Skeet Range is unlikely. Subtitle D landfills for disposal of the PAH-contaminated soil are located within 100 to 200 miles of TEAD, and an asphalt batching plant is located within approximately 15 miles of TEAD.

  Although the use of soil washing to remove lead shot from soil has been successfully implemented at other sites, the number of vendors with experience in using this treatment technology is limited. (Two such vendors were identified during the preparation of this CMS.) A TDSF is located within 100 miles of TEAD with can treat the soil before disposal or dispose soil directly in a Subtitle C landfill. To meet the CAOs, approximately 4 months is required for excavation, soil washing, off-post transportation/ disposal, and backfilling.

– Safety – Alternative 2 poses moderate short-term risks to off-post residential communities and onsite workers. Residential communities may be exposed to the contaminated soil during transportation and off-post disposal. Onsite workers may be exposed to contaminated soil during excavation, soil washing, and other soil-handling activities. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

– Human health assessment – Excavation, soil washing, and off-post treatment/disposal of contaminated soil protect human health by preventing both short- and long-term soil exposure.

– Environmental assessment – Alternative 2 reduces the risk to ecological receptors by removing metals COCs from the soil that remains at the site, and by removing the PAH-contaminated soil from the site. This alternative reduces the initial ecological risk by 97 to 100 percent for the various receptors at SWMU 57. However, some elevated residual risk remains for vegetation and the deer mouse. The remaining residual risk for vegetation includes EQs of 5, 3.2, and 8 for antimony, arsenic, and lead respectively. The residual risk for the deer mouse includes EQs of 11.8 and 3.1 for antimony and lead, respectively. Nevertheless, based on the conservative exposure assumptions used in the ecological RA (SAIC, 1997), these residual risks are still considered to be in the acceptable range.

  It should also be noted that the ecological risk calculations conservatively assume the treated material will only be treated to residential CAOs. However, it is likely that this alternative will reduce metal concentrations to background. Soil that does not pass cleanup goals after lead shot removal

will be stabilized and disposed at an off-post landfill and replaced with clean fill.

- Administrative feasibility – Alternative 2 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by treating the metals-contaminated soil and by removing the PAH-contaminated soil from the site. Because the soil containing lead, antimony, arsenic, and PAHs above their respective CAOs is excavated and either treated or removed from SWMU 57, this alternative meets the human health risk criteria under UAC R315-101-6. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil that is shipped off post is transported in accordance with DOT regulations. This alternative may require a RCRA permit to treat hazardous waste onsite.

- Cost – The estimated present worth cost of implementing Alternative 2 is $1,600,000. This cost may be lower if only a small percent of the soil requires additional treatment (i.e., solidification). Table A-26 (Appendix A) presents the detailed cost estimate. The cost will be further decreased if the stabilized soil can be placed on-post instead of at an off-post landfill.

9.2.3 Alternative 3 – Excavation, Solidification/Stabilization, and Off-Post Treatment/ Disposal

As part of Alternative 3, both the metals- and the PAH-contaminated soil are excavated using a backhoe, scraper, or other similar equipment. Figure 9-2 shows the metals-contaminated areas (north area). The analytical data presented in the Phase II RFI (SAIC, 1997) indicate that most of the metals contamination at SWMU 57 is limited to shallow soil, at depths of 6 inches or less.

Confirmatory soil samples are collected from the floor and sidewalls of the excavations, and analyzed for lead, antimony, and arsenic. Soil is excavated until the quantitative CAOs for lead, antimony, and arsenic are met. An XRF field instrument may be used to aid in identifying the extent of lead contamination. For purposes of the CMS, it is assumed that the metals-contaminated soil is excavated to an average depth of 1 foot, resulting in a total volume of 1,930 yd^3.

The metals-contaminated soil is treated onsite by solidification/stabilization, and the stabilized waste is then transported to an off-post Subtitle C or D landfill for final placement. Solidification/stabilization processes typically employ a variety of agents, such as cement, fly ash, lime-based materials, or other additives. Some processes reduce contaminant mobility by physically incorporating the contaminants in a solid matrix, thereby reducing contact between the contaminants and infiltration or runoff, while other processes chemically bind the constituents in the solidified matrix.

Because most of the lead and other metals detected in the soil at SWMU 57 are contained in the lead pellets associated with skeet shooting, the soil is solidified to produce a soil cement material. (Chemical stabilization is not expected to immobilize the lead present in the pellets.) Depending on the agents used, the solidification/stabilization process may be effective in chemically immobilizing some of the lead and other metals that may have migrated to the soil as a result of weathering and dissolution of the lead pellets.

Pretreatment testing is required prior to final design of the solidification/stabilization system to evaluate the effectiveness of this technology on the metals-contaminated soil from SWMU 57, and to select and optimize the stabilization reagent formulation. The pretreatment optimization is to include TCLP tests to evaluate the ability of the solidification/stabilization process to convert the contaminated soil to a nonhazardous material in accordance with RCRA. The testing is expected to produce information on the strength, durability, volume increase, and long-term integrity of the stabilized material, and on design criteria for the treatment process. For purposes of the CMS, it is assumed that Portland cement is the primary reagent to be used, and that the volume increase due to treatment of the soil is 20 percent.

In implementing the solidification/stabilization process, the excavated metals-contaminated soil is stockpiled and blended before being fed to a mixing device together with the selected reagents. The treated soil from the mixer is then discharged into forms constructed from plywood, where it is allowed to cure until the desired hardness is achieved. The length of the cure time is determined by the treatability study. The form size and shape are selected to facilitate transport and final placement of the treated soil (e.g., regular blocks). Before being disposed at a landfill, the treated soil is stockpiled, sampled, and tested to ensure that it is classified as a nonhazardous waste based on TCLP criteria for the metals COCs. The soil remains at the treatment facility and undergoes active treatment until the stabilized material meets TCLP and other immobilization requirements. Although the lead shot is not removed, the stabilized soil is expected to pass LDR and RCRA characteristic waste criteria. However, if soil profile testing by the TSDF for the stabilized soil does not meet these criteria, then the soil will not be accepted by landfills or TSDF. The treated soil will not be placed back into the excavated area at SWMU 57 because the site is slated for unlimited use and solidified blocks would be an obstruction.

Figure 9-3 shows the PAH-impacted area (south area). The PAH-contaminated soil is excavated to an assumed average depth of 1 foot; the volume of the excavated soil is estimated to be 1,590 yd^3. Confirmatory soil samples are collected from the floor and sidewalls of the excavation, and analyzed for PAHs. Excavation and confirmatory sampling continue until the quantitative CAOs for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are met.

As discussed in Section 9.2.1, soil profile analyses (including total waste and TCLP tests) are conducted for the PAH-contaminated soil to determine where the excavated soil may be properly disposed. For the purposes of this CMS and based on the analytical data presented in the Phase II RFI (SAIC, 1997), the south area soil is assumed to be classified as nonhazardous according to RCRA and State of Utah regulations. For cost estimating purposes the soil is assumed to be disposed at an off-post Subtitle D nonhazardous waste landfill. However, beneficial reuse of the soil in asphalt or road base could lower costs and should also be considered during the design phase. Soil which fails TCLP is disposed as hazardous as discussed in Section 9.2.1. The PAH-contaminated soil is transported and manifested in accordance with applicable regulations.

Clean soil from an on-post borrow site is backfilled into each of the excavated areas. A vegetative cover is placed over the top layer of clean soil to prevent surface water ponding, to minimize erosion, and to accommodate slope stability concerns.

Alternative 3 – excavation, solidification/stabilization, and off-post treatment/ disposal – is evaluated as follows:

- Technical criteria

  – Performance – Excavation, solidification/stabilization, and off-post treatment/disposal of contaminated soil are likely to meet both the quantitative and qualitative CAOs developed for SWMU 57. This alternative complies with UAC R315-101-3, the "Principle of Non-Degradation," by treating the metals-contaminated soil and removing both this treated soil and the PAH-contaminated soil from the site, thereby preventing the migration of contaminants to other environmental media. The qualitative CAOs are achieved by protecting human health and the environment from future exposure to these contaminants at the site. Alternative 3 is applicable to both site and contaminant characteristics. Because contaminants are physically removed from SWMU 57, the quantitative CAOs are met with no decrease in effectiveness over time.

    This alternative requires pretreatment testing to confirm the effectiveness of solidification/stabilization for classifying the metals-contaminated soil as nonhazardous based on TCLP test results. Although solidification/ stabilization is considered a permanent treatment process, there is a potential for the eventual breakdown of the material and release of contained metals. Pretreatment testing will more clearly quantify this potential and determine if this technology can meet CAOs in a cost-effective manner.

  – Reliability – Excavation, solidification/stabilization, and off-post treatment/disposal are effective for remediating contaminated areas over the long term, and have been effectively implemented at other sites. Alternative 3 eliminates future residential exposure to contaminated soil at the site.

Management of waste materials is limited to contaminated soil. Pretreatment testing will confirm if solidification/stabilization can achieve the CAOs. Some degree of long-term liability may be associated with final placement of the stabilized metals-contaminated soil in an off-post Subtitle D landfill, and with disposal of the PAH-contaminated soil in an off-post Subtitle D landfill or its use in asphalt products or road base.

- Implementability – Excavation equipment for this alternative is readily available. Because Alternative 3 requires excavation, subsurface utilities may possibly affect its implementation, though the presence of such obstructions at the Skeet Range is unlikely. Subtitle D landfills for disposal of the PAH-contaminated soil are located within 100 to 200 miles of TEAD, and an asphalt batching plant is located within approximately 15 miles of TEAD. In addition, a number of vendors provide solidification/stabilization services. To meet the CAOs, approximately 4 months is required for excavation, stabilization, off-post transportation/disposal, and backfilling.

- Safety – Alternative 3 poses moderate short-term risks to off-post residential communities and onsite workers. Residential communities may be exposed to the PAH-contaminated soil during transportation and off-post disposal. In addition, onsite workers may be exposed to contaminated soil during excavation, stabilization, and other soil-handling activities. However, this alternative includes the appropriate precautionary measures (e.g., dust suppression and personal protection equipment).

- Human health assessment – Excavation, solidification/stabilization, and off-post treatment/disposal of both treated and untreated contaminated soil protect human health by preventing both short- and long-term soil exposure.

- Environmental assessment – Excavation, solidification/stabilization, and off-post treatment/disposal of the treated and untreated contaminated soil reduce the risk to ecological receptors by removing the contaminated soil from the site. Alternative 3 reduces the initial ecological risk by 97 to 100 percent for the various receptors at SWMU 57. Some residual risk remains for vegetation (EQs of 4 and 3.1 for arsenic and lead, respectively) and for the deer mouse (EQs of 1.7 and 1.2 for antimony and lead, respectively). Based on the conservative assumptions used in the ecological RA (SAIC, 1997), which generally overestimate exposure, these residual risks are considered to be acceptable.

- Administrative feasibility – Alternative 3 complies with applicable Federal and State laws and regulations, including the requirements of UAC R315-101, by treating the metals-contaminated soil and by removing this treated soil and the untreated PAH-contaminated soil from the site. Because the soil containing lead, antimony, arsenic, and PAHs above their respective CAOs

is excavated and removed from SWMU 57, this alternative meets the human health risk criteria under UAC R315-101-6. Contaminated soil is excavated in accordance with UAC R307-12, Fugitive Emissions and Fugitive Dust. The excavated soil is transported in accordance with DOT regulations. The treated metals contaminated soil is sent to an off-post landfill because placement of this soil at another on-post, off-site location presents administrative difficulties. This alternative may require a RCRA permit to treat hazardous waste onsite.

- Cost – The estimated present worth cost of implementing Alternative 3 is $1,500,000. The estimate assumes treatment of the metals-contaminated soil onsite using solidification/stabilization and off-post disposal of the stabilized waste. The PAH-contaminated soil is disposed at an off-post Subtitle D landfill. Table A-29 (Appendix A) presents the detailed cost estimates.

9.3 COMPARATIVE ANALYSIS OF CORRECTIVE MEASURES ALTERNATIVES

Table 9-2 and the text below summarize the comparative analysis of the three corrective measures alternatives developed for the Skeet Range (SWMU 57).

- Technical criteria

  - Performance – Alternative 1 (excavation and off-post treatment/disposal) and Alternative 2 (excavation, soil washing, and off-post treatment/disposal) are rated high with respect to performance, while Alternative 3 (excavation, solidification/stabilization, and off-post treatment/disposal) is rated moderate. Each alternative meets both the qualitative and quantitative CAOs. Only Alternative 2 allows for recovery and recycling of most of the lead shot. However, both Alternatives 2 and 3 required pretreatment testing to show that can meet CAOs in a cost-effective manner.

  - Reliability – Alternative 1 is rated high for reliability because it has been proven effective at other sites and does not require onsite O&M activities. Alternatives 2 and 3 are rated moderate because pretreatment testing is required for each to further evaluate their effectiveness and permanence.

  - Implementability – Alternative 1 is easy to implement, and is rated high. Equipment and contractors for excavation, removal, and treatment/disposal are readily available. Alternatives 2 and 3 are rated moderate because on-site equipment and strict operational controls will be necessary. Only a relatively limited number of vendors are capable of performing lead shot removal/stabilization. Alternative 2 also requires soil dewatering. Soil

TABLE 9-2

Comparative Analysis of Corrective Measures Alternatives
Skeet Range (SWMU 57) (a)

Corrective Measures Alternatives	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost
	Performance	Reliability	Implementability	Safety				
1. Excavation and off-post treatment/disposal	High	High	High	Moderate	High	High	High	$1,400,000
2. Excavation, soil washing, and off-post treatment/disposal	High	Moderate	Moderate	Moderate	High	High	Moderate	$1,600,000
3. Excavation, stabilization, and off-post treatment/disposal	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	$1,500,000

(a) Rankings indicate how well each alternative meets the evaluation criterion, relative to other alternatives.

profile results conducted by Safety-Kleen show that the stabilized soil can be disposed in a landfill.

- Safety – Alternative 1 is rated moderate because it requires handling of contaminated soil and transporting the soil offsite for disposal. It presents short-term exposure to both onsite workers and offsite residential communities. Alternatives 2 and 3 require more onsite handling of contaminated soil than Alternative 1 due to soil washing and/or solidification/stabilization, but the material transported off post is treated; they are also rated moderate.

- Human health assessment – Alternatives 1, 2, and 3 are each rated high because they either remove contaminated soil from the site, or remove contaminants from soil that remains at the site.

- Environmental assessment – Alternatives 1, 2, and 3 are rated high for protection of ecological receptors; the removal of the metals- and the PAH-contaminated soil from SWMU 57 reduces potential ecological impacts by approximately 97 to 100 percent.

- Administrative feasibility – Alternative 1 is rated high because it meets the requirements of UAC R315-101. Alternative 1 has the least potential for operational problems because no on-site treatment is involved. While Alternative 2 also meets these requirements, it is rated moderate because it may require a RCRA permit for treating hazardous waste. Alternative 3 is rated moderate because placing the treated metals contaminated soil at another on-post location presents administrative difficulties so the treated soil is sent to an off-post landfill. Also Alternative 3 may require a RCRA permit for treating hazardous waste.

- Cost – Of the three alternatives, Alternative 1 costs the least – with an estimated total present worth cost of $1,400,000. The cost for Alternative 3 is estimated at $1,500,000. The cost for Alternative 2 is estimated at $1,600,000.

The cost for Alternative 2 is based on all of the metals contaminated soil requiring additional treatment (i.e., stabilization) after lead shot removal. These costs will be lower if only a fraction of the soil requires additional treatment. The costs for Alternative 2 will also be lower if the treated soil is disposed on-post.

9.4 RECOMMENDED ALTERNATIVE

Based on the comparative analysis presented in Section 9.3, Alternative 1 – excavation and off-post treatment/disposal – is the recommended alternative for SWMU 57 because:

- It meets the quantitative and qualitative CAOs, including protection of human health and the environment, and compliance with UAC R315-101-3, the "Principle of Non-Degradation."

- It has been demonstrated at other sites.

- It is reliable.

- It can be safely implemented.

- It can be implemented at a lower cost than the other corrective measures alternatives.

- It has the least potential for operational problems because no on-site treatment is involved.

10.0 SUMMARY OF RECOMMENDED CORRECTIVE MEASURES ALTERNATIVES

Based on the evaluation of corrective measures alternatives, Section 10.0 lists the recommended alternatives for each of the SWMUs considered in this CMS. These recommendations are based on the evaluation criteria considered in the detailed analyses, as reported in Sections 3.0 through 9.0. Table 10-1 summarizes the evaluations conducted for SWMUs 49, 50, 51, 52, 54, 56, and 57.

10.1 SWMU 49

Deed restrictions to prevent future residential development is the recommended corrective measures alternative for the:

- Stormwater/Industrial Wastewater Piping, Sewer Line – Southern Area.
- Stormwater/Industrial Wastewater Piping, Sewer Line –Central Area.
- Stormwater/Industrial Wastewater Piping, Sewer Line –Northern Area.
- Stormwater/Industrial Wastewater Piping, B Avenue Outfall.
- Stormwater/Industrial Wastewater Piping, H Avenue Outfall.
- Stormwater/Industrial Wastewater Piping, J Avenue Outfall.
- Stormwater/Industrial Wastewater Piping, K Avenue Outfall.

No action is the recommended corrective measures alternative for the Stormwater/Industrial Wastewater Piping, Building 609.

Excavation, off-post treatment/disposal, and deed restrictions is the recommended corrective measures alternative for the Stormwater/Industrial Wastewater Piping, G Avenue Outfall.

10.2 SWMU 50

Deed restrictions to prevent future residential development is the recommended corrective measures alternative for the:

- Compressor Condensate Drains, Building 613.
- Compressor Condensate Drains, Building 619.

10.3 SWMU 51

Deed restrictions to prevent future residential development is the recommended corrective measures alternative for the Chromic Acid/Alodine Drying Beds.

10.4 SWMU 52

Deed restrictions to limit future residential development is the recommended corrective measures alternative for the Disposal Trenches, SWMU 52B.

Excavation and off-post treatment/disposal is the recommended corrective measures alternative for the:

- Charcoal Material Area, SWMU 52C.
- Horse Stable Area, SWMU 52D.

10.5 SWMU 54

No action is the recommended corrective measures alternative for the Sandblast Areas, Building 604.

Excavation, off-post treatment/disposal, and deed restrictions is the recommended corrective measures alternative for the Sandblast Areas, Building 611.

Deed restrictions to prevent future residential development is the recommended corrective measures alternative for the Sandblast Areas, Building 637.

10.6 SWMU 56

Excavation and off-post treatment/disposal is the recommended corrective measures alternative for the Gravel Pit.

10.7 SWMU 57

Excavation and off-post treatment/disposal is the recommended corrective measures alternative for the Skeet Range.

TABLE 10-1

Summary of Comparative Analysis of Corrective Measures Alternatives
Group C SWMUs
Tooele Army Depot

SWMU	Technical Evaluation							
Corrective Measures Alternative (a)	**Performance**	**Reliability**	**Implementability**	**Safety**	**Human Health Assessment**	**Environmental Assessment**	**Administrative Feasibility**	**Cost ($)**
SWMU 49 STORMWATER/INDUSTRIAL WASTEWATER PIPING								
Sewer Line – Southern Area								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
Excavation, off-post treatment/ disposal, and deed restrictions	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Depth of contamination and presence of sewer line effect implementation	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	No effects	Meets requirements of UAC R315-101	47,000
Sewer Line – Central Area								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
Excavation, off-post treatment/ disposal, and deed restrictions	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Depth of contamination and presence of sewer line effect implementation	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	No effects	Meets requirements of UAC R315-101	52,000
Sewer Line – Northern Area								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
Building 609								
No action	---	---	---	---	---	---	---	---
B Avenue Outfall								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000

TABLE 10-1 (cont'd)

SWMU	Technical Evaluation							
Corrective Measures Alternative (a)	**Performance**	**Reliability**	**Implementability**	**Safety**	**Human Health Assessment**	**Environmental Assessment**	**Administrative Feasibility**	**Cost ($)**
G Avenue Outfall								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Prevents residential exposure but industrial workers exposed to SVOCs	No effects	Meets requirements of UAC R315-101	12,000
Excavation, off-post treatment/ disposal, and deed restrictions	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Reduces risk	Meets requirements of UAC R315-101	73,000
H Avenue Outfall								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
J Avenue Outfall								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
K Avenue Outfall								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
SWMU 50 COMPRESSOR CONDENSATE DRAINS								
Building 613								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
Building 619								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000

TABLE 10-1 (cont'd)

SWMU	Technical Evaluation				Human Health Assessment	Environmental Assessment	Administrative Feasibility	Cost ($)
Corrective Measures Alternative (a)	**Performance**	**Reliability**	**Implementability**	**Safety**				
Alternative 2: Excavation and off-post treatment/ disposal	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	No effects	Meets requirements of UAC R315-101	26,000
SWMU 51 CHROMIC ACID/ALODINE DRYING BEDS								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
SWMU 52 POSSIBLE DRAIN FIELD/DISPOSAL TRENCHES								
Disposal Trenches (52B)								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste management, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
Charcoal Material Area (52C)								
Excavation and off-post treatment/ disposal	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Further reduces already low risk	Meets requirements of UAC R315-101	550,000
Horse Stable Area (52D)								
Excavation and off-post treatment/ disposal	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Further reduces already low risk	Meets requirements of UAC R315-101	41,000
SWMU 54 SANDBLAST AREAS								
Building 604								
No action	---	---	---	---	---	---	---	---

TABLE 10-1 (cont'd)

SWMU	Technical Evaluation							
Corrective Measures Alternative (a)	**Performance**	**Reliability**	**Implementability**	**Safety**	**Human Health Assessment**	**Environmental Assessment**	**Administrative Feasibility**	**Cost ($)**
Building 611								
Alternative 1: Excavation, off-post treatment/ disposal, and deed restrictions	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Further reduces already low risk	Meets requirements of UAC R315-101 and UAC R315-101-6	120,000
Alternative 2: Excavation, soil washing, and deed restrictions	Meets identified CAOs, but pre-treatment tests are required	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill for fined grained contaminated soil	Limited number of commercial vendors experienced with soil washing	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Further reduces already low risk	Meets requirements of UAC R315-101 and UAC R315-101-6; may require RCRA permit	260,000
Alternative 3: Excavation, solidification/stabilization, and deed restrictions	Meets identified CAOs, but pre-treatment tests are required	Proven effective at other sites; requires no O&M, 5 year inspections of stabilized soil recommended	Limited number of commercial vendors available	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Further reduces already low risk	Meets requirements of UAC R315-101 and UAC R315-101-6; may require RCRA permit	210,000
Building 637								
Deed restrictions	Meets identified CAOs	Requires no O&M, waste manage-ment, or long-term monitoring	Easily implemented under current conditions	Not of concern	Protects human health	No effects	Meets requirements of UAC R315-101	12,000
SWMU 56 GRAVEL PIT								
Alternative 1: Deed restrictions	Does not meet identified CAOs	Requires no O&M, waste manage-ment, or long-term monitoring	Easily implemented under current conditions	Not of concern	Does not protect human health	No effects	Does not meet requirements of UAC R315-101	12,000
Alternative 2: Excavation and off-post treatment/ disposal	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Reduces risk	Meets requirements of UAC R315-101	240,000

TABLE 10-1 (cont'd)

SWMU	Technical Evaluation							
Corrective Measures Alternative (a)	**Performance**	**Reliability**	**Implementability**	**Safety**	**Human Health Assessment**	**Environmental Assessment**	**Administrative Feasibility**	**Cost ($)**
SWMU 57 SKEET RANGE								
Alternative 1: Excavation and off-post treatment/ disposal	Meets identified CAOs	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Easily implemented under current conditions	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Reduces ecological risk by 97 to 100%; low residual risks for vegetation and deer mouse; no unacceptable residual risks	Meets requirements of UAC R315-101 and UAC R315-101-6; lower potential for operational problems	1,400,000
Alternative 2: Excavation, soil washing, and off-post treatment/ disposal	Meets identified CAOs; offers recovery and recycling of lead shot, but pretreatment tests are required	Proven effective at other sites; requires no O&M or long-term monitoring onsite, but these activities are required at off-post landfill	Limited number of commercial vendors experienced with soil washing to remove lead shot	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Reduces ecological risk by 97 to 100%; moderate residual risks for vegetation and deer mouse; no unacceptable residual risks	Meets requirements of UAC R315-101 and UAC R315-101-6; may require RCRA permit	1,600,000
Alternative 3: Excavation, solidification/stabilization, and off-post treatment/disposal	Meets identified CAOs, but pretreatment tests are required	Proven effective at other sites; requires no O&M, 5 year inspections of stabilized soil recommended	Limited number of commercial vendors readily available	Short-term risk to off-post communities and onsite workers minimized by engineering and safety controls	Protects human health	Reduces ecological risk by 97 to 100%; low residual risks for vegetation and deer mouse; no unacceptable residual risks	Meets requirements of UAC R315-101 and UAC R315-101-6; may require RCRA permit; administratively difficult to move treated soil off-site to another on-post location for final placement	1,500,000

(a) The recommended corrective measures alternative is shown in bold italic type.

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APPENDIX A

Cost Estimating Assumptions

APPENDIX A

Cost Estimating Assumptions

This appendix presents assumptions for the development of cost estimates for the corrective measure alternatives evaluated in Sections 3.0 to 9.0 of the main text. The cost estimates made for this CMS are anticipated to provide an accuracy of +50 to -30 percent based on available data and best engineering judgment.

A.1 DIRECT CAPITAL COST ASSUMPTIONS

A.1.1 DEED RESTRICTIONS

- Includes a site management plan, survey, and legal description of the site.
- Includes administrative costs associated with incorporating deed restrictions into the deed created for the transfer of the BRAC parcel from TEAD to the buyer.
- Includes site inspections to ensure deed restrictions are being observed.

A.1.2 SOIL OPERATIONS ACTIVITIES

A.1.2.1 Mobilization/Demobilization

- Includes costs associated with mobilization and demobilization for soil operations activities. Cost is significantly higher for on-site treatment technologies (i.e. soil washing) which require extensive equipment.

A.1.2.2 Ground Preparation/Clearing

- Includes equipment and labor necessary for clearing of site vegetation as needed prior to corrective action activities.

A.1.2.3 Soil Excavation

- Includes labor and equipment necessary for the excavation of contaminated soil from sites to a nearby staging area for treatment or disposal activities. TCLP sampling will be conducted from soil staging area. Depth of excavation, which varies according to the site, is considered in the cost for each individual site. In general, the shallow excavation depths presented in this CMS do not require special safety measures such as shoring, access control, etc.

- Includes costs for water tank rental and personnel to wet exposed soil areas to minimize dust generation during excavation/backfilling.

- Includes materials, labor, and equipment necessary for temporary run-on and run-off control as a means of erosion control during remedial activities. Does not include permanent erosion control measures such as revegetation, which is included under a separate line item.

A.1.2.4 Backfilling

- Includes costs associated with hauling free backfill from on post (distance less than 6 miles), backfilling of excavated areas and compaction, as necessary. Units costs for backfill are increased to account for the increased costs associated with the uncompacted soil volumes.

A.1.2.5 Grading

- Includes equipment and labor needed for grading the surface of the site subsequent to corrective action activities to minimize ponding and erosion.

A.1.2.6 Gravel Cover

- Includes equipment, materials, and labor for the placement of a gravel cover over excavated and backfilled areas at the site.

A.1.2.7 Revegetation/Seeding

- Includes equipment, materials, and labor required for vegetation/seeding of the site. Assumes that the site has been previously cleared and major landscaping is not required. Indigenous vegetation will be used. Soil amendment, as necessary, is included.

A.1.3 CHEMICAL ANALYSES

A.1.3.1 Confirmation Sampling

- Includes labor, materials, and laboratory fees associated with collection, shipment, and chemical analysis of surface and subsurface soils samples.

- Assumes that two personnel conduct sampling. Number of samples collected is estimated as 10 percent of the cubic yards of soil excavated or treated except at SWMU 57 where the large quantity of excavated soil allows for sample number based on 5 percent of cubic yards.

A.1.3.2 Soil Profile and Analytical Costs

- Includes costs associated with conducting a soil profile and soil analysis, which are required prior to off-post landfill disposal as part of the waste acceptance criteria of the disposal site. Labor, equipment, shipment, and laboratory analysis are included. Number of samples collected is estimated as 1 percent of the cubic yards of soil excavated or treated.

A.1.3.3 Residual Profile and Analytical Costs

- Includes costs associated with conducting a treatment residuals profile and analysis, which are required prior to off-post landfill disposal. Labor, equipment, shipment, and laboratory analysis are included.

A.1.4 TREATMENT

A.1.4.1 Soil Washing

- Includes materials, labor, and equipment to perform bench-scale treatability studies to evaluate effectiveness, cost, and optimum design parameters, such as wash solution composition, flow rate, and throughput of a full-scale soil washing system.

- Includes labor, materials, and equipment necessary for treatment of contaminated soil with an appropriate soil washing technology. Costs associated with treatment of aqueous waste solution or other side waste streams generated during the soil washing process are included. Treated wash water is assumed to be reused during operation of the soil washing system. At the end of the project, the final wash water will be treated and disposed of as necessary.

- Includes revenues from sales of recovered lead pellets (where applicable).

A.1.4.2 Solidification/Stabilization

- Includes materials, labor, and equipment to perform bench-scale treatability studies to evaluate effectiveness, cost, and optimum design parameters of a full-scale solidification/stabilization system.

- Includes labor, equipment, and materials for treatment of soil using an appropriate solidification/stabilization technology. Optimum composition of the amendments used during treatment should be determined based on waste characteristics.

A.1.4.3 Treatment Pad, Temporary Building, and Stockpile Area

- Includes labor, equipment, and materials necessary to erect a concrete slab with a temporary building, sumps, sump pumps, decontamination pad, and stockpile storage area.

A.1.5 DISPOSAL

A.1.5.1 Transportation to Landfill

- Includes costs associated with transportation of wastes from the site to an off-post disposal facility within 100 miles of TEAD. Use of appropriately permitted commercial transportation vendors is assumed.

A.1.5.2 Landfill Disposal

- Includes costs associated with off-post disposal at an appropriate disposal facility. Results of confirmation sampling and soil profiling will be used to make the final determination concerning appropriate destinations for excavated materials (Subtitle C TSDF, Subtitle C landfill, or Subtitle D landfill). The type of disposal facility assumed in these cost estimates which can accept the excavated material is based on a preliminary review of site contaminants and potential waste processes contributing to contamination at each SWMU. Disposal costs assumed in remedial alternatives could change significantly if the final disposal determination differs from that assumed in CMS report.

A.1.5.3 Transport and Disposal at Asphalt Plant

- Includes costs associated with transportation and disposal of non-hazardous waste soil at an off-post asphalt batching plant.

A.2 O&M COST ASSUMPTIONS

A.2.1 5-YEAR INSPECTIONS FOR STABILIZED SOIL

- Five-year inspections would be conducted to confirm long-term effectiveness of the stabilization process. Includes costs to conduct TCLP tests and prepare letter reports.

A.3 INDIRECT CAPITAL COST ASSUMPTIONS

A.3.1 ENGINEERING AND CONSTRUCTION MANAGEMENT

- Costs associated with providing technical engineering support during the design and construction phases of various remedial activities are assumed to be 20 percent of total direct costs.

A.3.2 HEALTH AND SAFETY EQUIPMENT AND TRAINING

- Costs associated with providing health and safety equipment and training for use during remediation activities are assumed to be 5 percent of total direct costs.

A.3.3 LEGAL AND ADMINISTRATIVE

- Costs associated with any legal and administrative issues associated with implementation of the remedial action – such as coordination with Federal, State, and local agencies; landowners; and other authorities – are assumed to be 5 percent of total direct costs.

A.3.4 PROJECT MANAGEMENT

- Costs associated with providing technical direction, quality control, monthly progress reports, and invoice generation for the project are assumed to be 10 percent of total direct costs.

A.4 OTHER ASSUMPTIONS

The following are other general assumptions for development of cost estimates.

- The volume of soil after excavation is 25 percent greater than the volume to be excavated (i.e., no longer compacted).

- Each cubic yard of soil excavated is approximately 1.4 tons (based on density of 1.66 g/cm^3).

- The amount of residual soil to be landfilled after soil washing is 15 percent of that washed.

- For present worth calculations, the discount rate is 7 percent based on OSWER Directive No. 9355.3-20.

- The contingency cost is 20 percent of the subtotal cost of the alternative.

A.5 DETAILED COST ESTIMATES

Tables A-1 to A-27 summarize cost estimates for each alternative at each SWMU.

Table A-1: SWMU 49 (Sewer Line - Southern Area) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-2: SWMU 49 (Sewer Line - Southern Area) - Alternative 2: *Excavation, Off-Post Treatment/Disposal, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ea	5,000.00	5,000
Mobilization/demobilization	1	ls	5,000.00	5,000
Shoring & stormwater pipe bracing	1	ls	2,000.00	2,000
Ground Preparation/Clearing	11	sy	0.20	100
Soil Excavation	33	cy	20.00	700
Backfilling Clean Soil	33	cy	10.00	400
Confirmation Sampling	3	sample	175.00	600
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	33	cy	70.00	2,400
TSDF/Landfill Disposal Cost	46	ton	145.00	6,700
Grading	1	msf	48.00	100
Gravel cover	11	sy	4.00	100
Subtotal Direct Capital Costs				24,400
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				4,900
Health and Safety Equipment & Training (5% of direct costs)				1,300
Legal and Administrative (5% of direct costs)				1,300
Project Management (10% of direct costs)				2,500
Subtotal Indirect Capital Costs				10,000
Total Capital Costs				34,400
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	ea	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				38,400
Contingency (@ 20%)				7,680
Total Cost of Alternative				47,000

Key to unit abbreviations

cy	cubic yard
ea	each
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-3: SWMU 49 (Sewer Line - Central Area) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-4: SWMU 49 (Sewer Line - Central Area) - Alternative 2: *Excavation, Off-Post Treatment/Disposal, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ea	5,000.00	5,000
Mobilization/demobilization	1	ls	5,000.00	5,000
Shoring & stormwater pipe bracing	1	ls	2,000.00	2,000
Ground Preparation/Clearing	22	sy	0.20	100
Soil Excavation	63	cy	20.00	1,300
Backfilling Clean Soil	63	cy	10.00	700
Confirmation Sampling	6	sample	290.00	1,800
Soil Profile and Analytical Costs	2	sample	1,300.00	2,600
Transport to Subtitle D Landfill	66	cy	70.00	4,700
Subtitle D Landfill Disposal Cost	88	ton	50.00	4,400
Grading	1	msf	48.00	100
Gravel cover	22	sy	4.00	100
Subtotal Direct Capital Costs				27,800
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				5,600
Health and Safety Equipment & Training (5% of direct costs)				1,400
Legal and Administrative (5% of direct costs)				1,400
Project Management (10% of direct costs)				2,800
Subtotal Indirect Capital Costs				11,200
Total Capital Costs				39,000
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	ea	0	0
Subtotal O&M Costs				300
Present Worth Annual O&M (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				43,000
Contingency (@ 20%)				8,600
Total Cost of Alternative				52,000

Key to unit abbreviations

cy	cubic yard
ea	each
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-5: SWMU 49 (Sewer Line - Northern Area) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-6: SWMU 49 (B Avenue Outfall) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-7: SWMU 49 (G Avenue Outfall) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-8: SWMU 49 (G Avenue Outfall) - Alternative 2: *Excavation, Off-Post Treatment/Disposal, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ea	5,000.00	5,000
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	400	sy	0.20	100
Soil Excavation	135	cy	20.00	2,700
Backfilling Clean Soil	135	cy	10.00	1,400
Confirmation Sampling	14	sample	290.00	4,100
Soil Profile and Analytical Costs	2	sample	1,300.00	2,600
Transport to Subtitle D Landfill	135	cy	70.00	9,500
Subtitle D Landfill Disposal Cost	190	ton	50.00	9,500
Grading	4	msf	48.00	200
Revegation/Seeding	400	sy	0.22	100
Subtotal Direct Capital Costs				40,200
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				8,100
Health and Safety Equipment & Training (5% of direct costs)				2,100
Legal and Administrative (5% of direct costs)				2,100
Project Management (10% of direct costs)				4,100
Subtotal Indirect Capital Costs				16,400
Total Capital Costs				56,600
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	ea	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				60,600
Contingency (@ 20%)				12,120
Total Cost of Alternative				73,000

Key to unit abbreviations

cy	cubic yard
ea	each
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-9: SWMU 49 (H Avenue Outfall) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-10: SWMU 49 (J Avenue Outfall) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-11: SWMU 49 (K Avenue Outfall) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-12: SWMU 50 (Building 613 Drain) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-13: SWMU 50 (Building 619 Drain) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-14: SWMU 50 (Building 619 Drain) - Alternative 2: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Shoring	1	ls	2,000.00	2,000
Ground Preparation/Clearing	7	sy	0.20	100
Soil Excavation	18	cy	20.00	400
Backfilling Clean Soil	18	cy	10.00	200
Confirmation Sampling	2	sample	115.00	300
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	18	cy	70.00	1,300
TSDF/Landfill Disposal Cost	27	ton	145.00	4,000
Grading	1	msf	48.00	100
Gravel cover	1	sy	4.00	100
Subtotal Direct Capital Costs				14,800
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				3,000
Health and Safety Equipment & Training (5% of direct costs)				800
Legal and Administrative (5% of direct costs)				800
Project Management (10% of direct costs)				1,500
Subtotal Indirect Capital Costs				6,100
Total Capital Costs				20,900
Subtotal Cost of Alternative				20,900
Contingency (@ 20%)				4,180
Total Cost of Alternative				26,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table A-15: SWMU 51 - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-16: SWMU 52B - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-17: SWMU 52C - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Charcoal material survey (manhours)	160	hr	48.00	7,700
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	5,670	sy	0.20	1,200
Soil Excavation	1,890	cy	25.00	47,300
Backfilling Clean Soil	1,890	cy	10.00	18,900
Confirmation Sampling	30	sample	530.00	15,900
Soil Profile and Analytical Costs	15	sample	1,300.00	19,500
Transport to Subtitle D Landfill	1,890	cy	40.00	75,600
Subtitle D Landfill Disposal Cost	2,650	ton	50.00	132,500
Grading	6	msf	48.00	300
Revegation/Seeding	5,670	sy	0.22	1,300
Subtotal Direct Capital Costs				325,200
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				65,100
Health and Safety Equipment & Training (5% of direct costs)				16,300
Legal and Administrative (5% of direct costs)				16,300
Project Management (10% of direct costs)				32,600
Subtotal Indirect Capital Costs				130,300
Total Capital Costs				455,500
Subtotal Cost of Alternative				455,500
Contingency (@ 20%)				91,100
Total Cost of Alternative				550,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table A-18: SWMU 52D - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	56	sy	0.20	100
Soil Excavation	28	cy	20.00	600
Backfilling Clean Soil	28	cy	10.00	300
Confirmation Sampling	4	sample	215.00	900
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	28	cy	70.00	2,000
TSDF/Landfill Disposal Cost	40	ton	340.00	13,600
Grading	1	msf	48.00	100
Revegation/Seeding	56	sy	0.22	100
Subtotal Direct Capital Costs				24,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				4,800
Health and Safety Equipment & Training (5% of direct costs)				1,200
Legal and Administrative (5% of direct costs)				1,200
Project Management (10% of direct costs)				2,400
Subtotal Indirect Capital Costs				9,600
Total Capital Costs				33,600
Subtotal Cost of Alternative				33,600
Contingency (@ 20%)				6,720
Total Cost of Alternative				41,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table A-19: SWMU 54 (Building 611) - Alternative 1: *Excavation, Off-Post Treatment/Disposal, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	250	sy	0.20	100
Soil Excavation	160	cy	20.00	3,200
Backfilling Clean Soil	160	cy	10.00	1,600
Confirmation Sampling	16	sample	175.00	2,800
Soil Profile and Analytical Costs	3	sample	1,300.00	3,900
Transport to Subtitle C TSDF/Landfill	160	cy	70.00	11,200
TSDF/Landfill Disposal Cost	224	ton	145.00	32,500
Grading	3	msf	48.00	200
Gravel Cover	250	sy	4.00	1,000
Subtotal Direct Capital Costs				66,500
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				13,300
Health and Safety Equipment & Training (5% of direct costs)				3,400
Legal and Administrative (5% of direct costs)				3,400
Project Management (10% of direct costs)				6,700
Subtotal Indirect Capital Costs				26,800
Total Capital Costs				93,300
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	ea	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				97,300
Contingency (@ 20%)				19,460
Total Cost of Alternative				120,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-20: SWMU 54 (Building 611) - Alternative 2: *Excavation, Soil Washing, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Soil Washing Treatability Study	1	ls	30,000.00	30,000
Mobilization/Demobilization	1	ls	40,000.00	40,000
Ground Preparation/Clearing	250	sy	0.20	100
Treatment Pad and Stockpile Area	1	ls	10,000.00	10,000
Soil Excavation	160	cy	20.00	3,200
Backfilling	160	cy	8.00	1,300
Soil Washing (2)	224	ton	200.00	44,800
Confirmation Sampling	16	sample	175.00	2,800
Residuals Profile and Analytical Costs	3	sample	1,300.00	3,900
Transport to Subtitle C TSDF/Landfill	24	cy	70.00	1,700
TSDF/Landfill Disposal Cost	34	ton	145.00	5,000
Grading	3	msf	48.00	200
Gravel Cover	250	sy	4.00	1,000
Subtotal Direct Capital Costs				149,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				29,800
Health and Safety Equipment & Training (5% of direct costs)				7,500
Legal and Administrative (5% of direct costs)				7,500
Project Management (10% of direct costs)				14,900
Subtotal Indirect Capital Costs				59,700
Total Capital Costs				208,700
O&M Costs				
Site Inspections (hours per year)	5	hr/year	60	300
Five Year Site Reviews (3)	1	ea	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				212,700
Contingency (@ 20%)				42,540
Total Cost of Alternative				260,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) If acid leaching is not required in the soil washing process (as determined by the treatibility study) the cost of treatment could be decreased to approximately $100 per ton
(3) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-21: SWMU 54 (Building 611) - Alternative 3: *Excavation, Solidification/Stabilization, and Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ea	5,000.00	5,000
Stabilization Treatability Study	1	ls	30,000.00	30,000
Mobilization/Demobilization	1	ls	25,000.00	25,000
Ground Preparation/Clearing	250	sy	0.20	100
Treatment Pad and Stockpile Area	1	ls	10,000.00	10,000
Soil Excavation	160	cy	20.00	3,200
Backfilling/Cover	32	cy	10.00	400
Confirmation Sampling	16	sample	175.00	2,800
Soil Profile and Analytical Costs	3	sample	1,300.00	3,900
Stabilization	224	ton	75.00	16,800
Grading	3	msf	48.00	200
Gravel Cover	250	sy	4.00	1,000
Subtotal Direct Capital Costs				98,400
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				19,700
Health and Safety Equipment & Training (5% of direct costs)				5,000
Legal and Administrative (5% of direct costs)				5,000
Project Management (10% of direct costs)				9,900
Subtotal Indirect Capital Costs				39,600
Total Capital Costs				138,000
O&M Costs				
Site Inspections (hours per year)	5	hr/year	60	300
Five Year Site Reviews (2)	1	ea	0	0
Five Year Site Inspection for stabilized soil	1	ea	15000	15,000
Present Worth O&M Costs (30 years @ 7% Discount Rate)				36,340
Subtotal Cost of Alternative				174,340
Contingency (@ 20%)				34,868
Total Cost of Alternative				210,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-22: SWMU 54 (Building 637) - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-23: SWMU 56 - Alternative 1: *Deed Restrictions* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Deed Restrictions (1)	1	ls	5,000.00	5,000
Subtotal Direct Capital Costs				5,000
Indirect Capital Costs				
Legal and Administrative (5% of direct costs)				250
Project Management (10% of direct costs)				500
Subtotal Indirect Capital Costs				800
Total Capital Costs				5,800
O&M Costs				
Site Inspections (hours per year)	5	hour	60	300
Five Year Site Reviews (2)	1	each	0	0
Subtotal O&M Costs				300
Present Worth O&M Costs (30 years @ 7% Discount Rate)				4,000
Subtotal Cost of Alternative				9,800
Contingency (@ 20%)				1,960
Total Cost of Alternative				12,000

Key to unit abbreviations

ls	lump sum

(1) Capital costs for deed restrictions include a site management plan, survey, and legal description of the site.
(2) Cost for Base-wide Five Year Site Reviews is programmed as part of TEAD's program management budget.

Table A-24: SWMU 56 - Alternative 2: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	600	sy	0.20	200
Soil Excavation	400	cy	20.00	8,000
Backfilling Clean Soil	400	cy	10.00	4,000
Confirmation Sampling	40	sample	175.00	7,000
Soil Profile and Analytical Costs	4	sample	1,300.00	5,200
Transport to Subtitle C TSDF/Landfill	400	cy	70.00	28,000
TSDF/Landfill Disposal Cost	560	ton	145.00	81,200
Grading	6	msf	48.00	300
Revegation/Seeding	600	sy	0.22	200
Subtotal Direct Capital Costs				139,100
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				27,900
Health and Safety Equipment & Training (5% of direct costs)				7,000
Legal and Administrative (5% of direct costs)				7,000
Project Management (10% of direct costs)				14,000
Subtotal Indirect Capital Costs				55,900
Total Capital Costs				195,000
Subtotal Cost of Alternative				195,000
Contingency (@ 20%)				39,000
Total Cost of Alternative				240,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table A-25: SWMU 57 - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization/Stockpile Area	1	ls	20,000.00	20,000
Ground Preparation/Clearing	10,600	sy	0.20	2,200
Soil Excavation	3,520	cy	20.00	70,400
Backfilling Clean Soil	3,520	cy	10.00	35,200
Confirmation Sampling - metals	100	sample	175.00	17,500
Confirmation Sampling - PAHs	80	sample	290.00	23,200
Soil Profile and Analytical Costs	35	sample	1,300.00	45,500
Transport North Area Soil to Subtitle C TSDF/Landfill (1)	1,930	cy	40.00	77,200
Dispose North Area Soil at Subtitle C TSDF/Landfill (1)	2,700	ton	144.00	388,800
Transport South Area Soil to Subtitle D Landfill (2)	1,590	cy	30.00	47,700
Dispose South Area Soil at Subtitle D Landfill (2)	2,230	ton	50.00	111,500
Grading	10	msf	48.00	500
Revegation/Seeding	10,600	sy	0.22	2,400
Subtotal Direct Capital Costs				850,000
Indirect Capital Costs				
Engineering and Construction Management (15% of direct costs)				127,500
Health and Safety Equipment & Training (5% of direct costs)				42,500
Legal and Administrative (5% of direct costs)				42,500
Project Management (10% of direct costs)				85,000
Subtotal Indirect Capital Costs				297,500
Total Capital Costs				1,147,500
Subtotal Cost of Alternative				1,147,500
Contingency (@ 20%)				229,500
Total Cost of Alternative				1,400,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Metals-contaminated north area soil will be sent to a TSDF for treatment followed by landfill disposal.
(2) PAH-contaminated south area soil will be sent to an off-post Subtitle D landfill for disposal.

Table A-26: SWMU 57 - Alternative 2: *Excavation, Soil Washing, and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Stabilization Treatability Study	1	ls	40,000.00	40,000
Mobilization/Demobilization	1	ls	30,000.00	30,000
Ground Preparation/Clearing	10,600	sy	0.20	2,200
Treatment Pad and Stockpile Area	1	ls	20,000.00	20,000
Soil Excavation	3,520	cy	20.00	70,400
Backfilling	3,520	cy	10.00	35,200
Confirmation Sampling - metals	100	sample	175.00	17,500
Confirmation Sampling - PAHs	80	sample	290.00	23,200
Soil Profile and Analytical Costs	70	sample	1,300.00	91,000
Lead Shot Separation Washing of North Area Soil (1)	2,700	ton	45.00	121,500
Stabilization of North Area Soil (2)	2,700	ton	45.00	121,500
Transport Treated North Area Soil to Sub. D Landfill (2)	2,200	cy	30.00	66,000
Dispose Treated North Area Soil at Sub. D Landfill (2)	3,100	ton	50.00	155,000
Transport South Area Soil to Subtitle D Landfill (3)	1,590	cy	30.00	47,700
Dispose South Area Soil at Subtitle D Landfill (3)	2,230	ton	50.00	111,500
Reclaimation of Recovered Lead Pellets (4)	54,000	lb	-0.12	-6,500
Grading	10	msf	48.00	500
Revegetation/Seeding	10,600	sy	0.22	2,400
Subtotal Direct Capital Costs				950,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				190,000
Health and Safety Equipment & Training (5% of direct costs)				47,500
Legal and Administrative (5% of direct costs)				47,500
Project Management (10% of direct costs)				95,000
Subtotal Indirect Capital Costs				380,000
Total Capital Costs				1,330,000
Subtotal Cost of Alternative				1,330,000
Contingency (@ 20%)				266,000
Total Cost of Alternative				1,600,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Metals-contaminated north area soil will be separated from shot lead.
(2) Metals-contaminated north area soil will be stabilized on-site following lead shot removal and then sent to a Subtitle D landfill for disposal. Stabilized soil assumed to have 15 % more volume and weight.
(3) PAH-contaminated south area soil will be sent to an off-post Subtitle D landfill for disposal.
(4) Revenues from sale of recovered lead pellets.

Table A-27: SWMU 57 - Alternative 3: *Excavation, Solidification/Stabilization, and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Stabilization Treatability Study	1	ls	40,000.00	40,000
Mobilization/Demobilization	1	ls	25,000.00	25,000
Ground Preparation/Clearing	10,600	sy	0.20	2,200
Treatment Pad and Stockpile Area	1	ls	20,000.00	20,000
Soil Excavation	3,520	cy	20.00	70,400
Backfilling	3,520	cy	10.00	35,200
Confirmation Sampling - metals	100	sample	175.00	17,500
Confirmation Sampling - PAHs	80	sample	290.00	23,200
Soil Profile and Analytical Costs	35	sample	1,300.00	45,500
Stabilization of North Area Soil	2,700	ton	75.00	202,500
Transport Stab. North Area Soil to Subtitle D Landfill (1)	2,200	cy	30.00	66,000
Dispose Stabilized North Area Soil at Sub. D Landfill (1)	3,100	ton	50.00	155,000
Transport South Area Soil to Subtitle D Landfill (2)	1,590	cy	30.00	47,700
Dispose South Area Soil at Subtitle D Landfill (2)	2,230	ton	50.00	111,500
Grading	10	msf	48.00	500
Revegetation/Seeding	10,600	sy	0.22	2,400
Subtotal Direct Capital Costs				870,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				174,000
Health and Safety Equipment & Training (5% of direct costs)				43,500
Legal and Administrative (5% of direct costs)				43,500
Project Management (10% of direct costs)				87,000
Subtotal Indirect Capital Costs				348,000
Total Capital Costs				1,218,000
Subtotal Cost of Alternative				1,218,000
Contingency (@ 20%)				243,600
Total Cost of Alternative				1,500,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

(1) Metals-contaminated north area soil will be stabilized on-site and then sent to a Subtitle D landfill for disposal. Stabilized soil assumed to have 15 % more volume and weight.

(2) PAH-contaminated south area soil will be sent to an off-post Subtitle D landfill for disposal.

APPENDIX B

Post-Corrective Measures Ecological Risks at SWMU 57

Post-Corrective Measures Ecological Risks
at SWMU 57

B.1 INTRODUCTION

Based on the results of the RCRA Facility Investigation Report (SAIC, 1997) performed at the Tooele Army Depot (TEAD), each solid waste management unit (SWMU) was characterized as to the extent of ecological risk it posed. For those SWMUs characterized as posing unacceptable ecological risk, the SWERA recommended consideration of ecological risk reduction as part of corrective measures to be evaluated based on human health concerns. The purpose of this appendix is to outline the approach utilized in this CMS, and the results obtained in the evaluation of ecological risk under post-corrective measures activities for Group C SWMU 57, which was the only SWMU determined in the RFI to pose potentially unacceptable ecological risks.

B.2 METHODOLOGY

The RFI (SAIC, 1997) used only data from the initial round of sampling to evaluate ecological risk. The supplemental data set for which the lead shot was removed from the soil samples prior to chemical analysis was not used in the RFI to evaluate ecological risks.

Ecological risks to various receptors were calculated using a dynamic food chain model. Thus, risk estimates based on the dataset include both soil and prey consumption routes of exposure.

To evaluate alternative corrective measures for SWMU 57 in this CMS (see Section 9.0), the post corrective measures risks have been evaluated utilizing the methodology described in the RFI to originally quantify the ecological risk. In general, this method involves the following steps:

- Identify all data utilized in the RFI for each SWMU, and identify the main risk drivers (those COPCs which contribute to the ecological risk) at each SWMU for each receptor.

- Identify the corrective measures to be considered at the SWMU.

- Identify those sample locations that will be affected as a result of each corrective measure.

- Estimate post corrective measure soil concentrations for each sample previously identified.

- Recalculate the SWMU soil concentration terms, or reasonable maximum exposure concentration (RME) for the main risk drivers utilizing methods identified in the RFI (SAIC, 1997).

- Recalculate the risk quotients (EQs) for each receptor of concern at the SWMU utilizing the procedures identified in the RFI. Compare the recalculated SWMU risk estimate to the initial risk estimate presented in the RFI, and calculate the percent risk reduction associated with each corrective measure evaluated.

The method utilized to calculate ecological risk from the soil concentration (RME) of a COPC is calculated as:

$$EQ = \frac{EC}{TRV}$$

where:

EC = Exposure Concentration
TRV = Toxicity Reference Value for the receptor of concern

B.3 SKEET RANGE

B.3.1 Introduction

Based on the evaluation of concentrations of COPCs in soil and levels of exposure to ecological receptors, the Phase II RFI (SAIC, 1997) determined that lead poses a potential risk to vegetation, deer mice, jackrabbits, and kestrels at this SWMU. Their respective EQs were 3,200 for vegetation, 1,250 for deer mice, 10.3 for jackrabbits, and 147 for kestrels. All of these EQs are substantially above the background EQs. Antimony and arsenic in soils were also determined to exceed the EQ thresholds for vegetation, deer mice, jackrabbits, and kestrels. A number of other organic constituents, primarily PAHs, were detected in soil but were not evaluated due lack of toxicity reference values.

The Phase II RFI concluded that ecological risk is very high from lead and other metals associated with skeet shooting at SWMU 57. The SWERA (Rust E&I, 1997) classified this SWMU as posing low ecological risks, however, this classification was qualitative and performed prior to availability of all chemical data. Based on these factors, it was recommended that corrective measures be considered for ecological risk at this SWMU.

B.3.2 Ecological Risk Evaluation Strategy

The CMS Work Plan (Dames & Moore, 1998) indicated that corrective actions to be evaluated in the CMS Report for SWMU 57 should focus primarily on antimony, arsenic, and lead, based on the results of the human health and ecological RAs. Reductions in ecological risk are calculated based on post corrective measure soil concentrations of these COPCs. In general, this method involves the identification of the corrective measures to be considered at SWMU 57, the identification of those sample locations which will be affected as a result of each corrective measure, and recalculation of post corrective measure soil exposure concentrations. Given this information, the risk to receptors of concern can be recalculated utilizing the methodologies presented in detail in the RFI (SAIC, 1997), and summarized in Section B.2 of this appendix.

B.3.3 Estimation of Post Corrective Measure Soil Concentrations

The post corrective measures concentrations of the COPC risks drivers in soil at SWMU 57 are shown in Table B-1, which is presented at the end of this appendix. It should be noted that Table B-1 only includes data collected in 1995 as the initial Phase II sampling effort. It is assumed that corrective measures will be applied to reduce the soil concentrations of lead (and other COPCs) in portions of the site that contain samples SB-AOC2-01 through SB-AOC2-13. The locations of the above samples are shown in Appendix B of the CMS Work Plan (Dames & Moore, 1998).

Corrective measures considered for SWMU 57 are presented below, together with assumptions employed in the post corrective measures risk evaluations:

- Excavation and off-post disposal (Corrective Measures Alternative 1). For this corrective measure, it is assumed that the soil concentrations of all COPCs under consideration will be reduced to background levels (i.e., concentrations of metals in clean backfill).

- Excavation, soil washing, and off-post disposal (Corrective Measures Alternative 2). For this corrective measure, it was assumed that lead shot removal would reduce the concentrations of antimony and lead to their respective CAOs of 25 and 400 mg/kg. For arsenic, the concentration was reduced to the background value of 40 mg/kg, which was greater than the CAO for arsenic. Some or all of the soil will also be stabilized and disposed at an off-post landfill. Clean backfill would then replace this soil. To be conservative, the risk reduction calculation assumes cleanup only to CAO levels.

- Excavation, solidification/stabilization, and off-post disposal (Corrective Measures Alternative 3). For this corrective measure, it was assumed that post-remedial concentrations of COPCs at the impacted areas would be reduced to background (i.e., concentrations of metals in clean backfill).

For those samples within the designated corrective measures area, post corrective measures soil concentrations were substituted in the database for the original soil concentrations employed in the RFI. Specifically, for Corrective Measures 1 and 3, the concentration for antimony was taken to be 3.57 mg/kg, arsenic 40 mg/kg, and lead 156 mg/kg. This resulted in a new soil database for SWMU 57 for each corrective measure considered. Based on this new database, the Cterm (soil exposure term) was recalculated for each corrective measures alternative.

B.3.4 Estimated Post Corrective Measure Ecological Risks

The post corrective measures values of EQs are presented together with the corresponding baseline values in Tables B-2 through B-4 for vegetation, deer mouse, kestral, jack rabbit, and golden eagle. In addition, the % Risk Reduction values for each corrective measures alternative are also summarized in Exhibit B-1.

Overall, each of the proposed corrective measures alternatives reduced the original estimated risks by 97 to 100 percent. This reduction brought the majority of the EQs down to below a value of one. As seen in Tables B-2 to B-4, some of the EQs are still above 1 (the value assumed to indicate a potential for ecological risks). These values range between 1.2 to 11.8. Most of the higher EQs are for vegetation, with the exception of the potential risk posed by antimony (EQ=11.8) to deer mouse under Alternative 2. In general, Alternative 2 has the highest remaining risks based on post corrective soil concentrations. Alternatives 1 and 3 have the same post corrective risks since the concentrations of the COPCs are all reduced to background. The difference in risk reduction between the alternatives is because the ecological risk calculations for Alternatives 1 and 3 assume the backfill material will be clean soil with metal concentrations equal to background, while Alternative 2 assumes that backfill material will be soil washed material with antimony and lead concentrations equal to their residential CAOs. However, it is likely that soil washing will reduce metal concentrations to background and have a risk reduction equal to the other two alternatives.

Alternatives 1 and 3 provide the greatest amount of risk reduction, followed by Alternative 2. Based on the conservative assumptions used in the ecological risk assessment in the RFI (SAIC, 1997), the reduced risks are considered to be within an acceptable range for all three alternatives.

Exhibit B-1. Summary of Percent Risk Reduction Based on the CMS Remedial Alternatives.

	Alternative 1			Alternative 2			Alternative 3		
	Antimon	Arsenic	Lead	Antimon	Arsenic	Lead	Antimon	Arsenic	Lead
Vegetation	99.9	97.6	99.9	99.1	97.6	99.7	99.9	97.6	99.9
Deer Mouse	99.9	97.6	99.9	99.1	97.6	99.7	99.9	97.6	99.9
Kestral	na	97.7	99.9	na	97.7	99.7	na	97.7	99.9
Jack Rabbit	99.9	97.7	99.9	99.7	97.7	99.7	99.9	97.7	99.9
Golden Eagle	na	100	99.9	na	100	99.7	na	100	99.9

na - not applicable, no EQ was calculated in the RFI (SAIC, 1997).

[ ] - Boxed highlighted value indicates if recalculated EQ is still > 1.0.

TABLE B-1

SWMU 57 Calculation of RME Term for the Ecological Risk Assessment Corrective Measures Study - Tooele Army Depot, Tooele, UT.

	Initial Phase II Data			Alternative 1			Alternative 2			Alternative 3		
Sample ID	Sb	As	Pb	Sb	As	Pb	Sb	As	Pb	Sb	As	Pb
SB-AOC2-01	3040	840	150000	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-01	0.5	9.46	90	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-02	1.45	11.8	390	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-02	0.5	9.95	330	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-03	1.41	1700	160000	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-03	0.5	270	79000	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-04	1.16	14	140	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-04	0.5	9.92	28	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-05	0.5	13.4	180	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-05	0.5	9.87	48	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-06	0.5	268.42	78	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-07	0.5	8.88	29.5	3.57	40	156	25	40	400	3.57	40	156
SB-AOC2-08	0.5	6.7	23	3.57	40	156	25	40	400	3.57	40	156
Count	13	13	13	na	na	na	na	na	na	na	na	na
Mean	234.50	244.03	30025.88	na	na	na	na	na	na	na	na	na
Dev.	877.36	514.02	61530.44	na	na	na	na	na	na	na	na	na
t-Value	1.7823	1.7823	1.7823	na	na	na	na	na	na	na	na	na
Std. Error	433.70	254.09	30415.79	na	na	na	na	na	na	na	na	na
UCL	668.20	498.12	60441.68	3.57	40	156	25	40	400	3.57	40	156
Min	0.5	6.7	23	na	na	na	na	na	na	na	na	na
Max	3040	1700	160000	na	na	na	na	na	na	na	na	na
RME[1]	3040	1700	160000	3.57	40	156	25	40	400	3.57	40	156

[1]RME = Reasonable maximum exposure concentration for surface soil (0-1.0 ft) calculated using initial Phase II samples, initial RMEs obtained from the RFI (SAIC, 1997).
na - not applicable

TABLE B-2

Recalculated Exposure and Risk for Corrective Measure Alternative 1: Excavation and Off-Site Disposal at SWMU 57(Group C SWMUs), Tooele Army Depot.

EcoCOPCs	Site RME[1] (mg/kg)	Vegetation			Deer Mouse			Kestrel		
		TRV (mg/kg)	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics										
Antimony	3.57	5.00E+00	3.57	7.14E-01	9.94E-02	1.68E-01	1.69E+00	na	5.71E-02	na
Arsenic	40	1.00E+01	40	4.00E+00	6.48E-01	3.61E-01	5.56E-01	2.38E+01	1.28E+00	5.38E-02
Lead	156	5.00E+01	156	3.12E+00	7.61E+01	9.29E+01	1.22E+00	5.22E+00	7.49E-01	1.43E-01
Organics										
2-Methylnaphthalene	0.0513	na	0.0513	na	na	2.02E-03	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.367	na	na	1.44E-02	na	na	1.41E-03	na
Anthracene	1.43	na	1.43	na	na	5.62E-02	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	81.7	na	na	2.70E+00	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	na	26.8	na	5.14E+00	8.71E-01	1.70E-01	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	55.7	na	na	1.80E+00	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	20.6	na	na	6.59E-01	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	13	na	na	4.21E-01	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.0353	na	na	2.15E-01	na	na	1.13E-01	na
Chrysene	91.3	na	91.3	na	na	3.01E+00	na	na	2.22E+01	na
Dibenzo(a,h)anthracene	3.51	na	3.51	na	na	1.30E-01	na	na	5.39E+00	na
Diethylphthalate	0.279	na	0.279	na	2.36E+04	1.10E-02	4.65E-07	na	2.14E-04	na
Flouranthene	33.3	na	33.3	na	na	1.31E+00	na	na	1.39E+00	na
Flourene	0.197	na	0.197	na	na	7.74E-03	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	12.7	na	na	4.06E-01	na	na	2.44E+01	na
Phenanthrene	13.1	na	13.1	na	na	5.15E-01	na	na	2.01E-01	na
Pyrene	71.8	na	71.8	na	na	2.45E+00	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.00E+02	1.46	7.30E-03	2.83E+03	5.03E-02	1.78E-05	5.12E-01	1.12E-01	2.19E-01

[1]RME - Reasonable maximum exposure concentration taken from Table B-1.

na - not applicable EQ - Risk Quotient = EC/TRV

TABLE B-2 Continuded

Recalculated Exposure and Risk for Corrective Measure Alternative 1: Excavation and Off-Site Disposal at SWMU 57 (Group C SWMUs), Tooele Army Depot.

EcoCOPCs	Site RME (mg/kg)	Jackrabbit			Golden Eagle		
		TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics							
Antimony	3.57	4.99E-01	0.0404803	8.11E-02	na	5.71E-02	na
Arsenic	40	5.03E-01	0.1429266	2.84E-01	2.93E+03	1.28E+00	4.37E-04
Lead	156	5.89E+01	0.5952721	1.01E-02	6.43E+01	7.49E-01	1.16E-02
Organics							
2-Methylnaphthalene	0.0513	na	0.0003327	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.0023801	na	na	1.41E-03	na
Anthracene	1.43	na	0.0092741	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	0.210636	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	3.98E+00	0.0606397	1.52E-02	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	0.1219758	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	0.0396121	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	0.0284683	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.004341	na	na	1.13E-01	na
Chrysene	91.3	na	0.2353863	na	na	2.22E+01	na
Dibenzo(a,h)anthracene	3.51	na	0.0176527	na	na	5.39E+00	na
Diethylphthalate	0.279	1.83E+04	0.0018094	9.89E-08	na	2.14E-04	na
Flouranthene	33.3	na	0.2159625	na	na	1.39E+00	na
Flourene	0.197	na	0.0012776	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	0.0244211	na	na	2.44E+01	na
Phenanthrene	13.1	na	0.0849582	na	na	2.01E-01	na
Pyrene	71.8	na	0.2339011	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.19E+03	0.0050751	2.32E-06	6.28E+00	1.12E-01	1.79E-02

TABLE B-3

Recalculated Exposure and Risk for Corrective Measure Alternative 2: Excavation, Soil Washing, and Off-Site Disposal at SWMU 57 (Group C SWMUs), Tooele Army Depot.

EcoCOPCs	Site RME	Vegetation			Deer Mouse			Kestrel		
	(mg/kg)	TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics										
Antimony	25	5.00E+00	25	5.00E+00	9.94E-02	1.18E+00	1.18E+01	na	4.00E-01	na
Arsenic	40	1.00E+01	40	4.00E+00	6.48E-01	3.61E-01	5.56E-01	2.38E+01	1.28E+00	5.38E-02
Lead	400	5.00E+01	400	8.00E+00	7.61E+01	2.38E+02	3.13E+00	5.22E+00	1.92E+00	3.68E-01
Organics										
2-Methylnaphthalene	0.0513	na	0.0513	na	na	2.02E-03	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.367	na	na	1.44E-02	na	na	1.41E-03	na
Anthracene	1.43	na	1.43	na	na	5.62E-02	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	81.7	na	na	2.70E+00	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	na	26.8	na	5.14E+00	8.71E-01	1.70E-01	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	55.7	na	na	1.80E+00	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	20.6	na	na	6.59E-01	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	13	na	na	4.21E-01	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.0353	na	na	2.15E-01	na	na	1.13E-01	na
Chrysene	91.3	na	91.3	na	na	3.01E+00	na	na	2.22E+01	na
Dibenzo(a,h)anthracen	3.51	na	3.51	na	na	1.30E-01	na	na	5.39E+00	na
Diethylphthalate	0.279	na	0.279	na	2.36E+04	1.10E-02	4.65E-07	na	2.14E-04	na
Flouranthene	33.3	na	33.3	na	na	1.31E+00	na	na	1.39E+00	na
Flourene	0.197	na	0.197	na	na	7.74E-03	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	12.7	na	na	4.06E-01	na	na	2.44E+01	na
Phenanthrene	13.1	na	13.1	na	na	5.15E-01	na	na	2.01E-01	na
Pyrene	71.8	na	71.8	na	na	2.45E+00	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.00E+02	1.46	na	2.83E+03	5.03E-02	1.78E-05	5.12E-01	1.12E-01	2.19E-01

TABLE B-3 Continued

Recalculated Exposure and Risk for Corrective Measure Alternative 2: Excavation, Soil Washing, and Off-Site Disposal at SWMU 57, (GropuC SWMUs), Tooele Army Depot.

EcoCOPCs	Site RME (mg/kg)	Jackrabbit			Golden Eagle		
		TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics							
Antimony	25	4.99E-01	0.2834755	5.68E-01	na	4.00E-01	na
Arsenic	40	5.03E-01	0.1429266	2.84E-01	2.93E+03	1.28E+00	4.37E-04
Lead	400	5.89E+01	1.5263388	2.59E-02	6.43E+01	1.92E+00	2.99E-02
Organics							
2-Methylnaphthalene	0.0513	na	0.0003327	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.0023801	na	na	1.41E-03	na
Anthracene	1.43	na	0.0092741	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	0.210636	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	3.98E+00	0.0606397	1.52E-02	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	0.1219758	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	0.0396121	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	0.0284683	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.004341	na	na	1.13E-01	na
Chrysene	91.3	na	0.2353863	na	na	2.22E+01	na
Dibenzo(a,h)anthracene	3.51	na	0.0176527	na	na	5.39E+00	na
Diethylphthalate	0.279	1.83E+04	0.0018094	9.89E-08	na	2.14E-04	na
Flouranthene	33.3	na	0.2159625	na	na	1.39E+00	na
Flourene	0.197	na	0.0012776	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	0.0244211	na	na	2.44E+01	na
Phenanthrene	13.1	na	0.0849582	na	na	2.01E-01	na
Pyrene	71.8	na	0.2339011	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.19E+03	0.0050751	2.32E-06	6.28E+00	1.12E-01	1.79E-02

TABLE B-4

Recalculated Exposure and Risk for Corrective Measure Alternative 3: Excavation, Solidification/Stabilization, and Off-Site Dosposal at SWMU 57, (Group C SWMUs) , Tooele Army Depot.

EcoCOPCs	Site RME (mg/kg)	Vegetation			Deer Mouse			Kestrel		
		TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics										
Antimony	3.57	5.00E+00	3.57	7.14E-01	9.94E-02	1.68E-01	1.69E+00	na	5.71E-02	na
Arsenic	40	1.00E+01	40	4.00E+00	6.48E-01	3.61E-01	5.56E-01	2.38E+01	1.28E+00	5.38E-02
Lead	156	5.00E+01	156	3.12E+00	7.61E+01	9.29E+01	1.22E+00	5.22E+00	7.49E-01	1.43E-01
Organics										
2-Methylnaphthalene	0.0513	na	0.0513	na	na	2.02E-03	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.367	na	na	1.44E-02	na	na	1.41E-03	na
Anthracene	1.43	na	1.43	na	na	5.62E-02	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	81.7	na	na	2.70E+00	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	na	26.8	na	5.14E+00	8.71E-01	1.70E-01	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	55.7	na	na	1.80E+00	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	20.6	na	na	6.59E-01	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	13	na	na	4.21E-01	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.0353	na	na	2.15E-01	na	na	1.13E-01	na
Chrysene	91.3	na	91.3	na	na	3.01E+00	na	na	2.22E+01	na
Dibenzo(a,h)anthracen	3.51	na	3.51	na	na	1.30E-01	na	na	5.39E+00	na
Diethylphthalate	0.279	na	0.279	na	2.36E+04	1.10E-02	4.65E-07	na	2.14E-04	na
Flouranthene	33.3	na	33.3	na	na	1.31E+00	na	na	1.39E+00	na
Flourene	0.197	na	0.197	na	na	7.74E-03	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	12.7	na	na	4.06E-01	na	na	2.44E+01	na
Phenanthrene	13.1	na	13.1	na	na	5.15E-01	na	na	2.01E-01	na
Pyrene	71.8	na	71.8	na	na	2.45E+00	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.00E+02	1.46	na	2.83E+03	5.03E-02	1.78E-05	5.12E-01	1.12E-01	2.19E-01

TABLE B-4 Continued

Recalculated Exposure and Risk for Corrective Measure Alternative 3: Excavation, Solidification/Stabilization, and Off-Site Disposal at SWMU 57, (Group C SWMUs) , Tooele Army Depot.

EcoCOPCs	Site RME	Jackrabbit			Golden Eagle		
	(mg/kg)	TRV	EC (mg/kg)	Site EQ	TRV	EC (mg/kg)	Site EQ
Inorganics							
Antimony	3.57	4.99E-01	0.04048	8.11E-02	na	5.71E-02	na
Arsenic	40	5.03E-01	0.14293	2.84E-01	2.93E+03	1.28E+00	4.37E-04
Lead	156	5.89E+01	0.59527	1.01E-02	6.43E+01	7.49E-01	1.16E-02
Organics							
2-Methylnaphthalene	0.0513	na	0.00033	na	na	3.12E-10	na
Acenaphthene	0.367	na	0.00238	na	na	1.41E-03	na
Anthracene	1.43	na	0.00927	na	na	2.20E-02	na
Benzo(a)anthracene	81.7	na	0.21064	na	na	1.99E+01	na
Benzo(a)pyrene	26.8	3.98E+00	0.06064	1.52E-02	na	1.29E+01	na
Benzo(b)flouranthene	55.7	na	0.12198	na	na	3.39E+01	na
Benzo(g,h,I)perylene	20.6	na	0.03961	na	na	3.96E+01	na
Benzo(k)flouranthene	13	na	0.02847	na	na	7.90E+00	na
Benzyl Alcohol	0.0353	na	0.00434	na	na	1.13E-01	na
Chrysene	91.3	na	0.23539	na	na	2.22E+01	na
Dibenzo(a,h)anthracen	3.51	na	0.01765	na	na	5.39E+00	na
Diethylphthalate	0.279	1.83E+04	0.00181	9.89E-08	na	2.14E-04	na
Flouranthene	33.3	na	0.21596	na	na	1.39E+00	na
Flourene	0.197	na	0.00128	na	na	1.51E-03	na
Ideno(1,2,3-cd)pyrene	12.7	na	0.02442	na	na	2.44E+01	na
Phenanthrene	13.1	na	0.08496	na	na	2.01E-01	na
Pyrene	71.8	na	0.2339	na	na	6.89E+00	na
di-n-butylphthalate	1.46	2.19E+03	0.00508	2.32E-06	6.28E+00	1.12E-01	1.79E-02

APPENDIX C

Cost Estimates for Unrestricted Use
Corrective Measures

INTRODUCTION

Recent Army guidance focuses on the application of institutional controls (ICs) at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. The guidance is presented in the memorandum "Army Guidance on Using Institutional Controls (ICs) in the CERCLA Process," issued on September 4, 1998, by the Assistant Chief of Staff for Installation Management, Department of the Army (U.S. Army, 1998). Although the guidance is primarily directed to ICs in relation to Base Realignment and Closure (BRAC) transfers, it also presents general principles applicable to active military installations. Appendix D of the CMS Work Plan (Dames & Moore, 2000) provides a brief explanation of the Army policy regarding ICs and implements the guidance at selected Group C solid waste management units (SWMUs).

To comply with the recent Army guidance, a corrective measure that remediates a site so that it is suitable for unrestricted use is evaluated for SWMUs 49, 50, 51, 54, and 56 in the CMS Work Plan. However, the SWMU 49 sewer line exposure areas are not evaluated because the sewer lines are located underground and so no complete exposure pathways exist. This corrective measure includes excavation of contaminated soil and off-post treatment/disposal. This applies to all soil that:

- Contains COCs at concentrations above residential CAOs.
- Poses a cancer risk above 1×10^{-6}.
- Poses a noncancer hazard index (HI) greater than 1.0.
- Results in a blood lead level above 10 micrograms per deciliter (μg/dL) for children (11.1 μg/dL for adults).

The excavation and off-post treatment/disposal corrective measure includes provisions for confirmation sampling to ensure that the soil contaminated at levels above CAOs is removed.

The goal of the following evaluation is primarily intended to provide a comparison of long-term costs of remediation versus ICs.

C.1 BUILDING 609 (SWMU 49)

C.1.1 Cost Comparison

No corrective action is recommended for Building 609.

C.1.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, there are no surface or subsurface COCs at Building 609 that require corrective action for future residential use.

- A review of the human health RA indicates that thallium, which is present at a concentration below the comprehensive basewide background, drives the unacceptable noncancer HIs at this site.

- No corrective actions are recommended at Building 609.

C.2 B AVENUE OUTFALL (SWMU 49)

C.2.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 140 yd^3 of the contaminated soil at the B Avenue Outfall is $96,000. The attached table (Table C-1) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-6) is $12,000. See Appendix A for that cost table.

C.2.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, lead is the only surface soil COC at the B Avenue Outfall.

- A review of the human health RA indicates that metals and PAHs contribute to the unacceptable risks at this site.

- Corrective action is recommended at sample locations containing the risk drivers benzo(a)anthracene, bis(2-ethylhexyl)phthalate, copper, nickel, and zinc, as well as locations with lead at concentrations above residential CAOs.

- Approximately 140 yd^3 of soil require corrective action to allow for unrestricted use of the B Avenue Outfall.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($96,000).

C.3 G AVENUE OUTFALL (SWMU 49)

C.3.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 200 yd^3 of the contaminated soil at the G Avenue Outfall is $82,000. The attached table (Table C-2) presents the detailed cost estimate. The estimated cost of implementing alternatives with ICs (Alternative 1, deed restrictions, Table A-7; and Alternative 2, excavation, off-post treatment/disposal, and deed restrictions, Table A-8) are $12,000 and $73,000, respectively. See Appendix A for these cost tables.

C.3.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, benzo(a)anthracene, benzo(a)pyrene, and benzo(a)fluoranthene are surface soil COCs at the G Avenue Outfall.

- A review of the human health RA indicates that PAHs drive unacceptable cancer risks at this site. Thallium contributes to the HI, but it is below background at the site.

- Corrective actions are recommended for the sample locations containing benzo(a)anthracene, benzo(a)pyrene, and benzo(a)fluoranthene at concentrations above residential CAOs.

- Approximately 200 yd^3 of PAH-contaminated soil require corrective action to allow for unrestricted use of the G Avenue Outfall.

- The cost of implementing the recommended alternative of excavation, off-post treatment/disposal, and deed restrictions ($73,000) is less than the cost of excavation and off-post treatment/disposal ($82,000).

C.4 H AVENUE OUTFALL (SWMU 49)

C.4.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 70 yd^3 of the contaminated soil at the H Avenue Outfall is $36,000. The attached table (Table C-3) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-9) is $12,000. See Appendix A for that cost table.

C.4.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, benzo(a)anthracene and benzo(a)fluoranthene are surface soil COCs at the H Avenue Outfall.

- A review of the human health RA indicates that these same PAHs drive unacceptable cancer risks at this site.

- Corrective actions are recommended at sample locations containing benzo(a)anthracene and benzo(a)fluoranthene at concentrations above residential CAOs.

- Approximately 70 yd^3 of soil require corrective action to allow for unrestricted use.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($36,000).

C.5 J AVENUE OUTFALL (SWMU 49)

C.5.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 4 yd^3 of the contaminated soil at the J Avenue Outfall is $15,000. The attached table (Table C-4) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-10) is $12,000. See Appendix A for that cost table.

C.5.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, there are no surface soil COCs at the J Avenue Outfall.

- A review of the human health RA conducted in the RFI indicates that only bis(2-ethylhexyl)phthalate drives unacceptable human health cancer risks at this site.

- Corrective actions are recommended at the sample location containing bis(2-ethylhexyl)phthalate.

- Approximately 4 yd^3 should be excavated to allow for unrestricted use at the J Avenue Outfall.

- The cost of implementing ICs ($12,000) is slightly less than the cost of excavation and off-post treatment/disposal ($15,000).

C.6 K AVENUE OUTFALL (SWMU 49)

C.6.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 130 yd^3 of the contaminated soil at the K Avenue Outfall is $57,000. The attached table (Table C-5) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-11) is $12,000. See Appendix A for that cost table.

C.6.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, there are no COCs at the K Avenue Outfall that require corrective action.

- A review of the RA conducted in the RFI indicates that benzo(a)anthracene, bis(2-ethylhexyl)phthalate, and thallium drive the unacceptable cancer and noncancer risks at this site, respectively.

- Thallium is present at concentrations below the comprehensive basewide background value.

- Corrective actions are recommended at the sample locations containing benzo(a)anthracene and bis(2-ethylhexyl)phthalate.

- Approximately 130 yd^3 of soil require corrective actions to allow for unrestricted use at the K Avenue Outfall.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($57,000).

C.7 BUILDING 613 (SWMU 50)

C.7.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 13 yd^3 of the contaminated soil at Building 613 is $23,000. The attached table (Table C-6) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-12) is $12,000. See Appendix A for that cost table.

C.7.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, there are no surface soil COCs at Building 613.
- A review of the human health RA indicates that copper and zinc contribute to unacceptable residential noncancer health effects.
- Corrective actions are recommended for soil containing copper and zinc at concentrations above the comprehensive basewide background level.
- Approximately 13 yd^3 of soil containing copper and zinc require corrective actions to allow for unrestricted use of SWMU 50, Building 613.
- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($23,000).

C.8 BUILDING 619 (SWMU 50)

C.8.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 18 yd^3 of the contaminated soil at Building 619 is $26,000. The attached table (Table C-7) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-13) is $12,000. See Appendix A for that cost table.

C.7.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, arsenic in subsurface soil is the only COC at Building 619.
- A review of the human health RA conducted in the RFI indicates that arsenic in one subsurface sample poses unacceptable residential human health risks via the produce ingestion pathway.
- Corrective actions are recommended for subsurface soil containing arsenic at a concentration above the construction worker CAO.
- It is estimated that approximately 18 yd^3 of soil require corrective actions to allow for unrestricted use of SWMU 50, Building 619.
- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($26,000).

C.9 CHROMIC ACID/ALODINE DRYING BEDS (SWMU 51)

C.9.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 11 yd^3 of the contaminated soil at SWMU 51 is $19,000. The attached table (Table C-8) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-15) is $12,000. See Appendix A for that cost table.

C.9.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, antimony, lead, benzo(a)anthracene, and benzo(b)fluoranthene are surface soil COCs at SWMU.

- A review of the human health RA conducted in the RFI indicates that these residential COCs also pose unacceptable residential human health risks.

- Corrective actions are recommend for soil at the three locations where antimony, lead, benzo(a)anthracene, and benzo(b)fluoranthene detections exceed the CAO.

- Approximately 11 yd^3 of soil require corrective action to allow for unrestricted use of SWMU 51.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($19,000).

C.10 BUILDING 604 (SWMU 54)

C.10.1 Cost Comparison

No corrective action is recommended for Building 604.

C.10.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC and CAOs, there are no surface or subsurface COCs at Building 604 that require corrective action to allow for unrestricted use.

- A review of the human health RA conducted in the RFI indicates that beryllium and thallium drive the human health risks, however they are each only found in one sample and are both below their respective comprehensive basewide background levels.

- No corrective action is necessary to allow for unrestricted use of Building 604.

C.11 BUILDING 611 (SWMU 54)

C.11.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 640 yd^3 of the contaminated soil at Building 611 is $380,000. The attached table (Table C-9) presents the detailed cost estimate. The estimated cost of implementing the least expensive alternative with ICs (Alternative 1, excavating, off-post treatment/disposal, and deed restrictions, Table A-19) is $120,000. See Appendix A for that cost table.

C.11.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC identified in the RFI Report (SAIC, 1997) and CAOs, antimony, cadmium, iron, and lead are surface soil COCs at Building 611 that require corrective action to allow for unrestricted use.

- A review of the RA conducted in the RFI indicates that cadmium, and lead drive the human health risks. Other risk drivers (bis(2-ethylhexyl)phthalate, copper, thallium, and zinc) are primarily co-located with areas of elevated cadmium and lead slated for removal.

- Corrective actions are recommended at the locations where cadmium and lead detections exceed the CAO.

- Approximately 640 yd^3 of contaminated soil require corrective action to allow for unrestricted use of Building 611.

- The cost of implementing excavation, off-post treatment/disposal, and deed restrictions ($120,000) is less than the cost of excavation and off-post treatment/disposal ($380,000).

C.12 BUILDING 637 (SWMU 54)

C.12.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 100 yd^3 of the contaminated soil at Building 637 is $71,000. The attached table (Table C-10) presents the detailed cost estimate. The

estimated cost of implementing an alternative with ICs (Alternative 1, Table A-22) is $12,000. See Appendix A for that cost table.

C.12.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC identified in the RFI (SAIC, 1997) and CAOs, lead, benzo(a)anthracene, and benzo(b)fluoranthene are surface soil COCs at Building 637 that require corrective action.

- A review of the human health RA indicates that lead, benzo(a)anthracene, and benzo(b)fluoranthene primarily contribute to drive the human health risks.

- Corrective actions are recommended for soil where lead, benzo(a)anthracene, and benzo(b)fluoranthene detections exceed the CAO.

- An estimated 100 yd^3 of soil require corrective action to allow for unrestricted use of Building 637.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($71,000).

C.13 GRAVEL PIT (SWMU 56)

C.13.1 Cost Comparison

The estimated cost of implementing excavation and off-post treatment/disposal without institutional controls for 400 yd^3 of the contaminated soil at the Gravel Pit is $240,000. The attached table (Table C-11) presents the detailed cost estimate. The estimated cost of implementing an alternative with ICs (Alternative 1, Table A-23) is $12,000. See Appendix A for that cost table.

C.13.2 Summary

- Based on a comparison between the maximum detected concentrations of each COPC identified in the RFI Report (SAIC, 1997) and CAOs, antimony and lead are surface COCs at SWMU 56 that require corrective action to allow for unrestricted use.

- A review of the human health RA conducted in the RFI indicates that antimony, beryllium, cadmium, copper, lead, thallium, and zinc drive the human health risks.

- Corrective action is recommend for soil where antimony and lead detections exceed the CAOs.

- Approximately 400 yd^3 of contaminated soil requires corrective actions to allow for unrestricted use of SWMU 56.

- The cost of implementing ICs ($12,000) is less than the cost of excavation and off-post treatment/disposal ($240,000).

Corrective actions are recommended at this site. The volume of contaminated soil under residential and industrial CAOs is estimated to be the same, and unrestricted use of this site is advantageous (but not required). Therefore a non IC alternative is recommended for the Gravel Pit.

Table C-1: SWMU 49 (B Avenue Outfall) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	420	sy	0.20	100
Soil Excavation	140	cy	20.00	2,800
Backfilling Clean Soil	140	cy	10.00	1,400
Confirmation Sampling	14	sample	390.00	5,500
Soil Profile and Analytical Costs	2	sample	1,300.00	2,600
Transport to Subtitle C TSDF/Landfill	140	cy	70.00	9,800
TSDF/Landfill Disposal Cost	200	ton	145.00	29,000
Grading	4	msf	48.00	200
Revegation/Seeding	420	sy	0.22	100
Subtotal Direct Capital Costs				56,500
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				11,300
Health and Safety Equipment & Training (5% of direct costs)				2,900
Legal and Administrative (5% of direct costs)				2,900
Project Management (10% of direct costs)				5,700
Subtotal Indirect Capital Costs				22,800
Total Capital Costs				79,300
Subtotal Cost of Alternative				79,300
Contingency (@ 20%)				15,860
Total Cost of Alternative				96,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-2: SWMU 49 (G Avenue Outfall) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	600	sy	0.20	200
Soil Excavation	200	cy	20.00	4,000
Backfilling Clean Soil	200	cy	10.00	2,000
Confirmation Sampling	20	sample	290.00	5,800
Soil Profile and Analytical Costs	2	sample	1,300.00	2,600
Transport to Subtitle D Landfill	200	cy	70.00	14,000
Subtitle D Landfill Disposal Cost	280	ton	50.00	14,000
Grading	6	msf	48.00	300
Revegation/Seeding	600	sy	0.22	200
Subtotal Direct Capital Costs				48,100
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				9,700
Health and Safety Equipment & Training (5% of direct costs)				2,500
Legal and Administrative (5% of direct costs)				2,500
Project Management (10% of direct costs)				4,900
Subtotal Indirect Capital Costs				19,600
Total Capital Costs				67,700
Subtotal Cost of Alternative				67,700
Contingency (@ 20%)				13,540
Total Cost of Alternative				82,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-3: SWMU 49 (H Avenue Outfall) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	214	sy	0.20	100
Soil Excavation	70	cy	20.00	1,400
Backfilling Clean Soil	70	cy	10.00	700
Confirmation Sampling	7	sample	290.00	2,100
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle D Landfill	70	cy	70.00	4,900
Subtitle D Landfill Disposal Cost	100	ton	50.00	5,000
Grading	2	msf	48.00	100
Revegation/Seeding	214	sy	0.22	100
Subtotal Direct Capital Costs				20,700
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				4,200
Health and Safety Equipment & Training (5% of direct costs)				1,100
Legal and Administrative (5% of direct costs)				1,100
Project Management (10% of direct costs)				2,100
Subtotal Indirect Capital Costs				8,500
Total Capital Costs				29,200
Subtotal Cost of Alternative				29,200
Contingency (@ 20%)				5,840
Total Cost of Alternative				36,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-4: SWMU 49 (J Avenue Outfall) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	11	sy	0.20	100
Soil Excavation	4	cy	20.00	100
Backfilling Clean Soil	4	cy	10.00	100
Confirmation Sampling	2	sample	290.00	600
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	4	cy	70.00	300
TSDF/Landfill Disposal Cost	6	ton	145.00	900
Grading	1	msf	48.00	100
Revegation/Seeding	11	sy	0.22	100
Subtotal Direct Capital Costs				8,600
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				1,800
Health and Safety Equipment & Training (5% of direct costs)				500
Legal and Administrative (5% of direct costs)				500
Project Management (10% of direct costs)				900
Subtotal Indirect Capital Costs				3,700
Total Capital Costs				12,300
Subtotal Cost of Alternative				12,300
Contingency (@ 20%)				2,460
Total Cost of Alternative				15,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-5: SWMU 49 (K Avenue Outfall) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	390	sy	0.20	100
Soil Excavation	130	cy	20.00	2,600
Backfilling Clean Soil	130	cy	10.00	1,300
Confirmation Sampling	13	sample	290.00	3,800
Soil Profile and Analytical Costs	2	sample	1,300.00	2,600
Transport to Subtitle D Landfill	130	cy	70.00	9,100
Subtitle D Landfill Disposal Cost	180	ton	50.00	9,000
Grading	4	msf	48.00	200
Revegation/Seeding	390	sy	0.22	100
Subtotal Direct Capital Costs				33,800
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				6,800
Health and Safety Equipment & Training (5% of direct costs)				1,700
Legal and Administrative (5% of direct costs)				1,700
Project Management (10% of direct costs)				3,400
Subtotal Indirect Capital Costs				13,600
Total Capital Costs				47,400
Subtotal Cost of Alternative				47,400
Contingency (@ 20%)				9,480
Total Cost of Alternative				57,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-6: SWMU 50 (Building 613 Drain) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Shoring	1	ls	2,000.00	2,000
Ground Preparation/Clearing	7	sy	0.20	100
Soil Excavation	13	cy	20.00	300
Backfilling Clean Soil	13	cy	10.00	200
Confirmation Sampling	2	sample	175.00	400
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	13	cy	70.00	1,000
TSDF/Landfill Disposal Cost	18	ton	145.00	2,700
Grading	1	msf	48.00	100
Gravel Cover	7	sy	4.00	100
Subtotal Direct Capital Costs				13,200
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				2,700
Health and Safety Equipment & Training (5% of direct costs)				700
Legal and Administrative (5% of direct costs)				700
Project Management (10% of direct costs)				1,400
Subtotal Indirect Capital Costs				5,500
Total Capital Costs				18,700
Subtotal Cost of Alternative				18,700
Contingency (@ 20%)				3,740
Total Cost of Alternative				23,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-7: SWMU 50 (Building 619 Drain) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Shoring	1	ls	2,000.00	2,000
Ground Preparation/Clearing	7	sy	0.20	100
Soil Excavation	18	cy	20.00	400
Backfilling Clean Soil	18	cy	10.00	200
Confirmation Sampling	2	sample	175.00	400
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	18	cy	70.00	1,300
TSDF/Landfill Disposal Cost	27	ton	145.00	4,000
Grading	1	msf	48.00	100
Gravel Cover	1	sy	4.00	100
Subtotal Direct Capital Costs				14,900
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				3,000
Health and Safety Equipment & Training (5% of direct costs)				800
Legal and Administrative (5% of direct costs)				800
Project Management (10% of direct costs)				1,500
Subtotal Indirect Capital Costs				6,100
Total Capital Costs				21,000
Subtotal Cost of Alternative				21,000
Contingency (@ 20%)				4,200
Total Cost of Alternative				26,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-8: SWMU 51 - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	33	sy	0.20	100
Soil Excavation	11	cy	20.00	300
Backfilling Clean Soil	11	cy	10.00	200
Confirmation Sampling	2	sample	175.00	400
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	11	cy	70.00	800
TSDF/Landfill Disposal Cost	16	ton	145.00	2,400
Grading	1	msf	48.00	100
Revegation/Seeding	33	sy	0.22	100
Subtotal Direct Capital Costs				10,700
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				2,200
Health and Safety Equipment & Training (5% of direct costs)				600
Legal and Administrative (5% of direct costs)				600
Project Management (10% of direct costs)				1,100
Subtotal Indirect Capital Costs				4,500
Total Capital Costs				15,200
Subtotal Cost of Alternative				15,200
Contingency (@ 20%)				3,040
Total Cost of Alternative				19,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-9: SWMU 54 (Building 611) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	1,280	sy	0.20	300
Soil Excavation	640	cy	20.00	12,800
Backfilling Clean Soil	640	cy	10.00	6,400
Confirmation Sampling	64	sample	175.00	11,200
Soil Profile and Analytical Costs	7	sample	1,300.00	9,100
Transport to Subtitle C TSDF/Landfill	640	cy	70.00	44,800
TSDF/Landfill Disposal Cost	900	ton	145.00	130,500
Grading	13	msf	48.00	700
Gravel Cover	1,280	sy	4.00	5,200
Subtotal Direct Capital Costs				226,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				45,200
Health and Safety Equipment & Training (5% of direct costs)				11,300
Legal and Administrative (5% of direct costs)				11,300
Project Management (10% of direct costs)				22,600
Subtotal Indirect Capital Costs				90,400
Total Capital Costs				316,400
Subtotal Cost of Alternative				316,400
Contingency (@ 20%)				63,280
Total Cost of Alternative				380,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-10: SWMU 54 (Building 637) - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	300	sy	0.20	100
Soil Excavation	100	cy	20.00	2,000
Backfilling Clean Soil	100	cy	10.00	1,000
Confirmation Sampling	10	sample	390.00	3,900
Soil Profile and Analytical Costs	1	sample	1,300.00	1,300
Transport to Subtitle C TSDF/Landfill	100	cy	70.00	7,000
TSDF/Landfill Disposal Cost	140	ton	145.00	20,300
Grading	3	msf	48.00	200
Gravel Cover	300	sy	4.00	1,200
Subtotal Direct Capital Costs				42,000
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				8,400
Health and Safety Equipment & Training (5% of direct costs)				2,100
Legal and Administrative (5% of direct costs)				2,100
Project Management (10% of direct costs)				4,200
Subtotal Indirect Capital Costs				16,800
Total Capital Costs				58,800
Subtotal Cost of Alternative				58,800
Contingency (@ 20%)				11,760
Total Cost of Alternative				71,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton

Table C-11: SWMU 56 - Alternative 1: *Excavation and Off-Post Treatment/Disposal* Cost Estimate

Item	Quantity	Unit	Unit Cost ($)	Total Cost ($)
Direct Capital Costs				
Mobilization/demobilization	1	ls	5,000.00	5,000
Ground Preparation/Clearing	600	sy	0.20	200
Soil Excavation	400	cy	20.00	8,000
Backfilling Clean Soil	400	cy	10.00	4,000
Confirmation Sampling	40	sample	175.00	7,000
Soil Profile and Analytical Costs	4	sample	1,300.00	5,200
Transport to Subtitle C TSDF/Landfill	400	cy	70.00	28,000
TSDF/Landfill Disposal Cost	560	ton	145.00	81,200
Grading	6	msf	48.00	300
Revegation/Seeding	600	sy	0.22	200
Subtotal Direct Capital Costs				139,100
Indirect Capital Costs				
Engineering and Construction Management (20% of direct costs)				27,900
Health and Safety Equipment & Training (5% of direct costs)				7,000
Legal and Administrative (5% of direct costs)				7,000
Project Management (10% of direct costs)				14,000
Subtotal Indirect Capital Costs				55,900
Total Capital Costs				195,000
Subtotal Cost of Alternative				195,000
Contingency (@ 20%)				39,000
Total Cost of Alternative				240,000

Key to unit abbreviations

cy	cubic yard
ea	each
load	per load
ls	lump sum
msf	thousand square feet
sample	per sample
sy	square yard
ton	per ton